

## Effects of fig seed flour on some quality parameters of cookies

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### Abstract

In the presented study, it was aimed to develop cookies with fig seed flour (FSF) and to determine their chemical, physical, textural and sensory parameters. FSF was replaced with wheat flour at 0%, 10% 20% and 30% levels in cookie formulation. FSF usage increased protein and ash content of cookies while it was provided with a considerable increment in total dietary fibre content (from 1.93% to 11.06% at 30% usage level of FSF). Increase at the diameter and spread ratio of cookies were observed and they were showed lower instrumental hardness by adding 10, 15 and 30% FSF (4362.3 kg to 3328.7 kg) when compared to control cookie (6394.8 kg). Usage of FSF led to cookies become darker and redder. On the other hand, their yellowness value was decreased in proportion to the rising FSF level. The developed cookies were found a high potential for acceptance and commercialisation. It is noteworthy that as the level of FSF in cookie formulations increased, purchasing score was also increased. It was concluded that the use of FSF in cookie production would improve dietary fibre, protein and mineral content, without affecting their technological quality or sensory acceptance.

**Key words:** Cookie, dietary fibre, fig seed, acceptance.

**Received: 24.05.2019**

**Accepted: 28.08.2019**

**Published (online): 03.09.2019**

### INTRODUCTION

*Ficus carica L.* is the member of the Moraceae family and has significant commercial importance for dry and fresh consumption and commonly referred to as “fig” (Barolo et al., 2014). Figs, native to Turkey and the eastern Mediterranean are one of the first plant cultivated by humans (Mawa et al., 2013). Areas, where the fig can be grown, are limited because it requires unique fertilisation and different drying possibilities compared to other fruits. Turkey has a great contribution to the world fruit production with its fresh figs production quantity (Gül and Akpınar, 2006). Total fig production in 2017 in the world was 1050.459 tonnes (FAO, 2019). Turkey is ranked first over the world with its 306.499 tonnes of fresh fig production in 2018 (TUİK, 2019). According to the latest statistical data (2016) of FAO; Turkey takes first place in terms of exportation (69.683 tonnes) of dried figs in the world (FAO, 2019).

Fresh and dried figs (*Ficus carica L.*) have higher amounts of phenolic compounds (Vallejo et al., 2012), superior quality antioxidants and most notably fiber. Thus they should be a greater part of the diet (Vinson et al., 2005). Alshaeri et al. (2014) reported that higher Ca, K, Fe and Cu intakes, with the consumption of dried figs. Dried figs have the best score among the dried fruits with their healthy nutrient composition (Barolo et al., 2014). Because of its higher health beneficial effects, *F.carica* has been traditionally used

for its medicinal and therapeutic benefits as metabolic, anti-inflammatory, respiratory, antispasmodic, laxative, and cardiovascular remedies (Mawa et al., 2013).

Dried figs are consumed as a snack. Besides they have various consumption areas such as in the pastry, dishes, bread, candies, desserts and fruit mixtures. They are used whole, concentrate, diced, powder or paste form in these foods. Low-quality figs are used to produce molasses and/or ethyl alcohol. The fig seeds arisen during the production of ethyl alcohol are also evaluated in the paint, cosmetic and pharmaceutical industries (Anonymous,2017).

Cookies are a shelf-stable product, and also they can be consumed at any time of the day by every age group. Monthly consumption of biscuits was reported by Gül et al. (2017) as 433.44 g in Isparta, Turkey. As a result of increasing demand to functional cookies formulated with several value-added ingredients, considerable development in the biscuit industry has been beginning.

### Cite this article as:

Gül, H., Ulutürk, Ş. 2019 Effects of fig seed flour on some quality parameters of cookies. Int. J. Agric. For. Life Sci., 3(2): 219-224.

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Consequently, a large number of ingredients and flours such as; grape pomace and grape seed flours (Acun and Gül, 2014), fenugreek seed (Wani et al., 2016), alfalfa seed (Giuberti et al., 2018), heat stabilized wheat germ (Gül et al., 2018) and *Hibiscus sabdariffa L.* seed powder (Nguyen et al., 2018), chia seed (O et al., 2019) have been supplemented in cookie formulations to improve their nutritional, functional and technological qualities.

Fig seeds after grinding to flour can also be considered as a functional ingredient in cookie formulations and/or other bakery products. To the best of our knowledge, no published studies focused on the usage of fig seed flour (FSF) in cookie formulation. In this study, we aimed to investigate the effect of the replacement of wheat flour with different percentages of FSF on chemical, physical, textural and sensorial properties of cookies.

## MATERIALS AND METHODS

### Materials

Vacuum packed FSF was obtained from Bir Numaralı Bitkisel Ürünler Gıda (Aydın, Turkey). Commercial cookie wheat flour from Türkmenler Milling Factory (Gaziantep, Turkey), corn syrup (42%) from Sunar Corn Integrated Plant Inc. (Adana, Turkey), sodium bicarbonate from Şişecam Chemicals Group Soda Industry (Mersin, Turkey), hydrogenated vegetable oil, fine granulated sugar and salt were purchased from local markets. All chemicals were used in analytical grade.

### Preparation of cookies

Cookies were produced in triplicate following the AACC Method 10-50.05 (AACC, 2000) with slight modifications. In the control cookies, FSF was not used. 10%, 20% and 30% of FSF were replaced with wheat flour in the FSF enriched cookies. 225 g wheat flour or wheat flour-FSF mixture, 130.0 g fine granulated sugar, 64 g hydrogenated vegetable oil, 33 g high fructose corn syrup (42%), 16.0 ml distilled water, 2.5 g sodium bicarbonate and 2.1 g salt were used in the cookie formulation.

The dough was kneaded with a mixer (Hobart, N-50, Germany) according to the procedure given in the method 10-50.05 (AACC, 2000). Subsequently, the dough was laminated to a thickness of 5 mm by rolling pin. The round form of the cookies was obtained by circular scone cutter 60 mm in diameter. The cookies were baked in an electric convection oven (Fimak FSET4, Turkey) at a temperature of  $205 \pm 5$  °C during 10 min. Afterwards, the cookies were cooled at ambient temperature (20–25°C) and packed in high density polyethylene bags with hermetic cover until further analysis.

### Chemical analysis

Moisture (Method 44-01.01), ash (Method 08-01.01), protein (Method 46-12.01), total lipid (Method 30-25.01), pH (Method 02-52.01) and total dietary

fibre (Method 32-05.01) content of control and cookies prepared with FSF were determined by using AACC Methods (AACC, 2000). Water activity (*aw*) of cookies were measured according to methods of Woody (2003) by using *aw*-meter (Novasina AG, LabSwift-*aw*, Switzerland).

### Physical analysis

Diameter (Width, W), thickness (T), and spread ratio (W/T) were calculated as reported by Gül et al. (2018). Colour values; L (lightness), a (redness) and b (yellowness) of cookies were measured by using colourimeter (Minolta CR410, Minolta Co Ltd., Tokyo, Japan). Average values were recorded after five readings for each measurement.

### Texture analysis

Hardness and “fracturability” of cookies were measured with 3-Point Bending Rig (HDP/3PB) of texture analyser (TA-XTplus, Stable Micro Systems, UK) with 5 kg load cell. Test parameters were performed as; pre-test speed: 1.0 mm/s, test speed: 3.0 mm/s, post-test speed; 10 mm/s, distance: 5.0 mm and data acquisition rate 500 pps.

### Sensory analysis

Sensory evaluation of all cookies was performed by fifteen untrained members of the Food Engineering Department of Süleyman Demirel University by using the sensory profiles method (Lawless and Heymann, 2010). Cookie samples were coded with three digits and served to panellist randomly. Glass of water was presented to panellists to rinse their mouth when crossing between samples. Cookies were evaluated in terms of colour, surface structure, texture (hardness and brittleness), flavour, odour, mouthfeel, overall acceptability, and purchasing intent. Hedonic scale from 1 to 5 point ‘dislike extremely’ to ‘like extremely’ was used, respectively.

### Statistical analysis

Statistical analysis of the cookies prepared with different amounts of FSF was evaluated according to Duncan’s multiple range test with significance defined at  $P < 0.01$ . Analysis of variance (ANOVA) was performed by using the software, statistical package for social science (SPSS 16.0). All the experiments were done in triplicate.

## RESULTS AND DISCUSSIONS

### Chemical composition of cookies

Moisture, ash, protein, total lipid, total dietary fibre, pH and *aw* values of cookies are given in Table 1. There is no significant difference between the moisture content of cookies. It is an important advantage that the moisture levels of cookies did not increase with the addition of FSF. Because high moisture content reduces eating quality by means of reducing brittleness. Higher moisture content (16.63%) of dried fig fruit had been found by Soni et

al. (2014). Because of its dry nature, FSF did not lead to an increase in the moisture content of cookies.

**Table 1.** Chemical composition of control and FSF enriched cookies<sup>1</sup>

FSF (%)	Moisture (%)	Ash (%)	Protein (%)	Total lipid (%)	Total dietary fibre (%)	pH	aw
0	6.15±0.16 <sup>a</sup>	1.32±0.00 <sup>d</sup>	9.70±0.01 <sup>b</sup>	13.73±0.02 <sup>c</sup>	1.93±0.12 <sup>d</sup>	7.30±0.00 <sup>c</sup>	0.45±0.00 <sup>a</sup>
10	7.69±0.40 <sup>a</sup>	1.43±0.02 <sup>c</sup>	12.33±0.10 <sup>a</sup>	13.80±0.04 <sup>bc</sup>	6.16±0.26 <sup>c</sup>	7.33±0.00 <sup>bc</sup>	0.44±0.01 <sup>a</sup>
20	7.30±0.18 <sup>a</sup>	1.54±0.00 <sup>b</sup>	13.00±0.08 <sup>a</sup>	14.28±0.01 <sup>b</sup>	8.74±0.20 <sup>b</sup>	7.40±0.01 <sup>b</sup>	0.44±0.01 <sup>a</sup>
30	6.33±0.79 <sup>a</sup>	1.56±0.00 <sup>a</sup>	13.00±0.10 <sup>a</sup>	15.15±0.02 <sup>a</sup>	11.06±0.27 <sup>a</sup>	7.50±0.00 <sup>a</sup>	0.39±0.00 <sup>b</sup>

<sup>1</sup>: There is no statistically significant difference between the averages indicated by the same letter in the same column (p<0.01).

All the FSF containing cookies had significantly higher levels of ash, protein, total lipid and total dietary fibre than the control made from 100% wheat flour (Table 1). As expected, with the addition of FSF in wheat flour increased, the ash content –indicates the higher mineral content- was increased due to the higher content of minerals in the FSF. Ash refers to the total amount of minerals present in food. High ash content (4.65%) of dried fig fruit indicates that it is a good source of minerals like strontium, calcium, magnesium, phosphorus and iron (Soni et al., 2014). Ficsor et al. (2013) stated that the eating five dkg of dried fig satisfies the more than 15% of the Recommended Dietary Allowances due to its contents of minerals for Ca, Cr, Cu, Fe, K, Mg, Mn and Mo.

There is no literature data on the nutrient content of fig seed supplemented cookies. Therefore the results of the presented study were compared with published data dealing with the composition of fresh and/or dried figs and cookies incorporated with other fruit seeds other than fig seeds.

Protein content was increased from 9.70% to 13.00% with the replacement of wheat flour with 30% FSF (Table 1). This limited increase in the protein content of cookies may be attributed to a moderate amount of protein content (4.67%) of dried fruit (Soni et al., 2014).

A slight increase in total lipid content of cookies about the control sample was achieved by incorporation of FSF, ranging from 10% to 30% (Table 1). Notably part of the bulk of dried fig consists of seeds may be large, medium, small or minute and range in number from 30 to 1,600 per fruit and these seeds are rich in oil (Kolesnik et al., 1986; Joseph and Raj, 2011).

Dried figs take an important place among dried fruits in nutritional point of view with their high fiber content (Vinson et al., 2005). Thus they have several health benefits with their good dietary fiber content (Soni et al., 2014). The most important improvement was observed in the dietary fiber content of cookies by the supplementation of FSF. Total dietary fiber content of cookies was increased from 1.93% (control) to 6.16%, 8.74% and 11.06% for 10%, 20% and 30% FSF containing cookies, respectively (Table 1). The findings suggest that FSF can be used in cookie formulations or other bakery products as a dietary fiber enhancer. Cookies supplemented with 10%,

20% and 30% FSF can be categorised in the source of fibre and high fibre food according to Regulation of the European Parliament of the Council (EC) No 1924/2006 of 20 December on Nutrition and Health Claims Made on Foods. In this regulation claims that a food is a source of fibre, and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 3 g of fibre per 100 g or at least 1.5 g of fibre per 100 kcal. A claim that a food is high in fibre, and any claim likely to have the same meaning for the consumer, may only be made where the product contains at least 6 g of fibre per 100 g or at least 3 g of fibre per 100 kcal (EC Regulation No 1924/2006).

Similar observations - an increase in the dietary content of cookies by the addition of different seeds- were reported by several researchers. In a previous study of Nguyen et al. (2018), the result shows that the increase of the fiber content in the cookies with *Hibiscus sabdariffa* L. seed powder. Acun and Gül (2014) have established that an increase in the dietary fibre content of cookies that include grape seed flour. Presentation of the higher fiber of the cookies incorporated with pumpkin seed (Moura et al., 2010), grape seeds (Kuchtová et al., 2018) also has been reported.

The addition of FSF to wheat flour cookies has slightly affected the pH and aw values of cookies (Table 1). Control cookie (7.33) was shown the lower pH (7.33) value, while the FSF added cookies were shown a gradual increase parallel to the FSF level. Although O et al. (2019) determined a lower pH of the cookies (6.31-6.41) containing roasted chia seed powders.

## Cookie Properties

### Geometrical Properties of Cookies

Measurements of geometrical and colour properties of cookies are presented in Table 2. The addition of FSF in cookie formulation resulted in a significant increase in diameter (W values) when the substitution level of FSF increased over 10% level. However, no significant difference was detected between control and FSF enriched cookies in terms of thickness (T value). Spread ratio (W/T) of FSF enriched cookies was increased significantly compared to 100% wheat flour cookies (control). However, increasing the level of substitution from

10% to 30% did not change the spread ratio significantly, a significant difference being observed between control and FSF cookies. Higher spread factor is the indicator of better cookie quality (Miller and Hosenev, 1997). The same results of an increase

in the spread ratio of cookies than the control cookies were also reported by O et al. (2019) and Kuchtová et al. (2018) after incorporating of 3% roasted chia seeds (180°C, 15 min) and by 15% grape seeds respectively.

**Table 2.** Physical properties of control and FSF enriched cookies<sup>1</sup>

FSF (%)	W (mm)	T (mm)	W/T	L	a	b
0	63.94±0.15 <sup>c</sup>	8.95±0.36 <sup>a</sup>	7.14±0.29 <sup>a</sup>	60.92±0.63 <sup>a</sup>	6.51±0.17 <sup>d</sup>	20.08±0.11 <sup>a</sup>
10	64.95±0.95 <sup>bc</sup>	8.18±0.10 <sup>a</sup>	7.94±0.08 <sup>b</sup>	51.38±0.07 <sup>b</sup>	7.81±0.08 <sup>c</sup>	17.94±0.01 <sup>b</sup>
20	66.47±0.88 <sup>ab</sup>	8.56±0.31 <sup>a</sup>	7.76±0.37 <sup>b</sup>	47.15±0.03 <sup>c</sup>	7.98±0.09 <sup>b</sup>	16.18±0.01 <sup>c</sup>
30	67.86±0.46 <sup>a</sup>	8.62±0.03 <sup>a</sup>	7.87±0.06 <sup>b</sup>	42.13±0.02 <sup>d</sup>	8.94±0.01 <sup>a</sup>	14.98±0.08 <sup>d</sup>

<sup>(1)</sup>: There is no statistically significant difference between the averages indicated by the same letter in the same column ( $p < 0.01$ ). W: Width, T: Thickness, W/T: Spread ratio, L: Lightness, a: redness, b: yellowness

### Colour properties of cookie samples

The lightness parameter L and yellowness parameter b were decreased linearly with the increasing level of FSF (Table 2). 30 % of FSF containing cookies showed the darkest colour. In contrast, a value (redness) of cookies containing FSF has exhibited an increasing trend with increasing substitution level of FSF. Darkening effect of FSF on cookies may be attributed to the natural pigments found naturally in the fig seeds and also Maillard reaction that produces desirable colours and flavours in baked products. Maillard reactions occur under alkaline conditions; thus, optimal browning takes place at pH 6–8. Therefore when the pH level of FSF enriched cookies (7.33-7.50) is regarded, it can be said that they have an optimal pH to occur Maillard reactions. Moreover, sugars in the FSF can enhance Maillard reactions. Acun and Gül (2014) and Kuchtová et al. (2018) reported a decreasing trend at lightness “L” and redness “a” while increasing trend at yellowness “b” values of the cookies with increasing substitution level of grape seed flours which were in agreement with our results.

### Textural properties of cookie samples

Textural properties of cookies can be observed in Table 3. The texture is an important quality evaluation factor of cookies (Giuberti et al., 2018). Replacement of a part of wheat flour with increasing levels of FSF decreased linearly the hardness of cookies which required less force to compress. The hardness value of control cookies was nearly 92% greater than the 30% FSF, including cookies. On the other hand, FSF usage in cookie formulation did not cause a considerable change in fracturability values of cookies. Our results are in line with those reported by Giami and Barber (2004) who found a gradual decrease on the hardness of the cookies when germinated pumpkin seed incorporated in the composite cookie at 5%, 10%, 15%, 20% and 25% levels. In contrast to our results, Rajiv et al. (2012) and Awolu et al. (2018) reported an increased at the breaking strength of cookies with the increase in the level of flaxseed and defatted mango kernel seed flour respectively.

**Table 3.** Textural properties of control and FSF enriched cookies<sup>1</sup>

FSF (%)	Hardness (kg)	Fracturability (mm)
0	6394.8±572.53 <sup>a</sup>	39.20±0.43 <sup>a</sup>
10	4362.3±103.01 <sup>b</sup>	38.91±0.15 <sup>a</sup>
20	4062.5±109.94 <sup>c</sup>	38.83±0.11 <sup>a</sup>
30	3328.7±152.00 <sup>d</sup>	38.68±0.18 <sup>a</sup>

<sup>(1)</sup>: There is no statistically significant difference between the averages indicated by the same letter in the same column ( $p < 0.01$ ).

### Sensory evaluation of control and FSF enriched cookies

The effect of FSF addition on sensory attributes and overall acceptability of cookies were evaluated. The surface colour of the cookies was scored similarly to control cookies except 20% FSF containing cookies which were scored the least. Interestingly surface colour of 30% FSF supplemented cookies was more liked than others by the evaluators. Compared to control cookie, cookies containing FSF gave a similar

or slightly higher sensory score in terms of all sensorial properties. Also, the overall acceptability of 10% and 30% FSF added cookies was found as well as control samples.

Moreover, the odour of 30% FSF cookies was admired the most. Purchasing intent of cookies was linearly increased as the usage level of FSF increased. As a result, FSF had no detrimental effect on colour, taste, aroma, odour, overall acceptability and affordability of cookies. Furthermore, some sensorial

values, especially overall acceptability and purchasing intent of FSF supplemented cookies, were found higher than control cookies.

Our sensory scores showed that increasing levels of FSF in cookie formulation made cookies more attractive.

Whereas generally addition of fiber to cereal products at an increasing level lead them to become less attractive.

Therefore the positive sensorial evaluations of FSF at higher usage levels is an important advantage of for cookie producers and consumers. It could, therefore, be inferred that incorporation of 30% FSF into wheat flour resulted in cookies with acceptable sensory properties. However, in the literature, the use of fiber sources has been achieved in a less level than the present study to produce cookies with acceptable quality. Giami and Barber (2004) were produced acceptable cookies from wheat flour – pumpkin concentrate blends containing 5 – 15% protein concentrate from ungerminated seeds. Acun and Gül (2014) reported that the cookies containing up to 5% grape seed flour were most appreciated in terms of sensorial properties and purchasing intent. Maximum sensorially acceptable tamarind (*Tamarindus indica* L.) seed powder level was determined as 6% for cookies by Natukunda et al. (2015). Awolu et al. (2018) stated that of up to 25% mango kernel flour into wheat flour resulted in cookies with acceptable sensory properties.

## CONCLUSIONS

In this study, the effects of fig seed flour obtained from dried figs on the quality of cookies were investigated. Results of the present study conclude that the FSF can be used in cookie formulations or other oven-baked products as a valuable alternative for the enrichment of cookies. The results from chemical composition analysis showed that FSF addition increased the nutritional value of cookies in terms of protein, total lipid, total dietary fibre and ash (mineral) content without affecting their technological and sensorial quality. FSF addition at higher levels (30%) was increased the affordability of cookies compared with control. This indicates that the market share of FSF added cookies might be high if they are produced commercially. Also, usage of FSF as an additive in the other bakery products and also other food products will provide an economic contribution to fig producers.

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