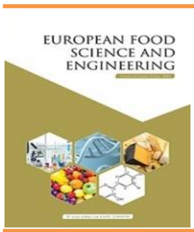

European Food Science and Engineering

Eur Food Sci Eng 2021, 2 (2), 59-64

https://dergipark.org.tr/tr/pub/efse

Effect of addition of fig seed cold press oil byproduct on physicochemical, sensory, textural and bioactive properties of bread

Elif Çakır[1*], Ruşen M. Yıldırım[2], Görkem Özülkü[2], Fatih Törnük[2], Ömer S. Toker[2], Osman Sağdıç[2] and Muhammet Arıcı[2]

[1] Department of Food Technology, School of Applied Science, Istanbul Aydin University, Istanbul 34295, Turkey
[2] Department of Food Engineering, Chemical and Metallurgical Faculty, Yıldız Technical University, Istanbul 34210, Turkey

ARTICLE INFO

Research Article
Article History:
Received: 15 October 2021
Accepted: 02 December 2021
Available Online: 06 December 2021
Keywords:
Fig seed
Cold press byproduct
Bread
Bioactive properties
Dietary fiber

ABSTRACT

This study was performed to assess the potential use of fig seed oil cold-press byproduct (FSB), as functional raw material for bread production. For this purpose, FSB was incorporated into bread formulation at different concentrations (0%, 1%, 2.5%, 5% or 7.5%) and its effect on some physicochemical, sensorial, textural and bioactive properties of bread was investigated. Increasing FSB contents resulted in ongoing and significant ($P<0.05$) decrease in L^* levels of both the crust and crumb of the samples while browning index increased. Dietary fiber reached to 0.62% by the addition of FSB. Total phenolic contents (TPCs) of both the crust and crumb varied from 339.55-532.79 mg GAE/g and 125.59-360.72 mg GAE/g, respectively while increasing FSB content resulted in higher ($P<0.05$) TPC values. DPPH radical scavenging activity also increased significantly ($P<0.05$) with the elevating FSB levels. Texture profile analysis showed that addition of 7.5% of FSB caused remarkable increasing effect on the hardness of the bread. Sensorial analysis revealed that breads containing FSB up to 5% were found acceptable. In conclusion, FSB could be used as a functional ingredient for development of nutritive properties of bread without negatively affecting their textural and sensorial properties depending on the concentration.

1. Introduction

In most countries, bread is consumed as a basic food item and is mostly produced from wheat flour. As a result of separation of bran and germ from the wheat flour, bread becomes poor in terms of minerals and vitamins as well as dietary fibers (Anon, 2003; Bender, 2006; Rakha et al., 2013). With the orientation of consumers toward healthy foods, the importance of the inclusion of diverse rich compounds in bread has increased significantly. By-products and wastes arising during the manufacture of a variety of food products have drawn great attention in recent years since they are considered as the rich sources of many bioactive compounds including dietary fibers, phenolic compounds, fatty acids, amino acids, prebiotics and minerals, vitamins, carotenoids and other phytochemicals (Baiano, 2014; Mirabella et al., 2014; Routray & Orsat, 2019). Polyphenols, a broad range of compounds with at least one aromatic ring structurally containing one or more hydroxyl groups, are included in the phytochemical class with potential biological activity in humans (Ignat et al., 2011; Quideau et al., 2011). The importance of bioactive compounds extracted from food industry byproducts has further increased with the aim of reducing various environmental problems caused by their disposal and also improving the micronutrient nutrition of societies helping to prevent obesity, diabetes, cancer and cardiovascular diseases (Kumar, 2020; Rakha et al., 2013). Cold pressing, as an environmentally friendly and inexpensive oil extraction method, also generates significant amounts of byproducts rich in various nutritive components (Karaman et al., 2015). Several attempts such as incorporation into food formulations and extraction of nutraceuticals have been conducted for valorization of cold press byproducts for valorization of cold press oil byproducts (Morales-de La Pena et al., 2021; Tekin-Cakmak et al., 2021; Wongwaiwech et al., 2020).

Fig (*Ficus carica* L.) is one of the first plants cultivated by humans and are among the most important crops in all around the world (Dueñas et al., 2008). Figs are fruits with very advanced nutritional properties (Yeganehzad et al., 2020), containing vitamins (B1, B2), minerals (iron, calcium, potassium), dietary fiber, antioxidants (Yang et al., 2009) and amino acids (Veberic et al., 2008), and other bioactive

*Corresponding author
E-mail address: elif.cakir@aydin.edu.tr

compounds. The primary and secondary metabolites, and their biological activity have made figs a focus of interest in research in recent years (Del Caro & Piga, 2008; Hssaini et al., 2019; Hssaini et al., 2020; Kamiloglu & Capanoglu, 2013). Although figs are mainly consumed as fresh or dried, they are also used for production of the seed oil. Fig seed oil has been characterized as the abundancy of linolenic acid. Other saturated and unsaturated fatty acids including linoleic, oleic, palmitic and stearic acids are also available in the oil (Ergun & Bozkurt, 2020; Jeong & Lachance, 2001). Limited number of studies is available in the literature for utilization of figs in food industry (Arvaniti et al., 2019; Hssaini et al., 2020; Schmitzer et al., 2011; Veberic et al., 2010). Fig seed cold press oil by product (FSB), to the best of our knowledge, has not been evaluated for inclusion in any food formulation as a functional ingredient. Therefore, the aim of this study is to investigate the potential use of FSB in bread formulation for enrichment in terms of dietary fibers and bioactive compounds and to reveal its effects on physicochemical, textural, bioactive and sensory properties of bread.

2. Materials and Methods

2.1. Materials

The pulp (FSB), a by-product of fig (*Ficus carica* L.), seed oil obtained by cold pressing the seeds was kindly supplied from Oneva Food Co. (Istanbul, Turkey). Wheat (*Triticum aestivum* L.) additive-free flour was obtained from the flour factory (Istanbul, Turkey). Folin-Ciocalteu's phenol reagent, methanol, gallic acid, Na_2CO3, DPPH, and Trolox were obtained from Merck (Darmstadt, Germany).

2.2. Bread production

Five wheat flour batches were prepared by substitution of wheat flour with 0, 1.0, 2.5, 5.0 or 7.5% of FSB. The flour samples (100 g) were incorporated 1.5% salt, 2 % fresh baker's yeast and ~60 mL water (determined by farinograph). All the ingredients were kneaded to optimum dough development in the mixer (Kitchen aid, Model 5K SM 150, USA), for 8 min at 4 speed. After complete mixing, dough was placed in the fermentation cabinet (Nuve TK 252, Turkey) at 30 °C and 85% relative humidity. The total duration of the fermentation was 115 min. After the first 30 min, the dough is taken out of the fermentation cabinet and its air is removed. A second punch was also given 30 min later. The dough was then shaped and placed in the fermentation cabinet for the last 55 min. Baking was performed at 235°C for 25 min in an electric oven (Maksan MKF-4P, Turkey). Afterwards the bread was taken out of the oven and cooled to room temperature for 2 h before analyses.

2.3. Color measurement

The color of the crust and crumb was measured as *L*, a** and *b* values* using a Chroma meter (CR-100 Konica Minolta, Japan) device. The measurement was done from at least 5 different points of the sample and the mean value was calculated.

2.4. Determination of dietary fiber content

Determination of dietary fiber contents of the bread samples were conducted using the dietary fiber assay kit (Megazyme International Ireland Ltd, Wicklow, Irealand) based on AACC method 32-05.01 and AOAC Method 985.29.

2.5. Determination of total phenolic content (TPC)

The crust and crumb were removed from bread samples and then dried at 40 °C for 24 h in a vacuum oven. Dry samples weighing 10 g were extracted in 80% methanol for 2 h using a mechanical stirrer. The methanolic extract was collected after removal of the solvent by a rotary evaporator. The TPCs of the methanolic extracts of crust and crumb bread samples were determined using the Folin-Ciolcalteu phenol reactive according to the procedure described by Singleton and Rossi (Singleton & Rossi, 1965). The samples were diluted 1:5 with distilled water and 0.5 mL diluted extracts were placed in a tube. Then, 2.5 mL Folin–Ciocalteu phenol reagent was added into the tube and after 3 min 2 mL of 2% (w/v) Na_2CO_3 was added. The prepared mixture was left in the dark at room temperature for 30 min and the absorbance of the sample was measured at 760 nm using a spectrophotometer (Shimadzu UV-1800 spectrophotometer, Japan. Gallic acid equivalents (GAE) in milligrams per gram of dry material and the values were presented as mean ± standard deviation of triplicate analysis.

2.6. Determination of antiradical activity

For 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging analysis, 0.1 ml the extract sample in methanol (0.1 mM) (Singh et al., 2002) was mixed with 5 mL DPPH solution and incubated at 27 °C for 20 min. Then the absorbance of the sample (Abs sample) was measured at 517 nm at using a spectrophotometer (Shimadzu UV-1800 spectrophotometer, Japan). Pure methanol was used as control. The results were expressed as mg Trolox equivalent (TE)/L sample (Singh et al., 2002).

2.7. Texture profile analysis

Texture Profile Analysis (Shevkani et al., 2015) was conducted by using TA.XT2 Plus Texture Analyzer (SMS, UK) equipped with 5 kg load cell and 36mm diameter cylindrical compression probe according to AACC Method 74-09.0 (AACC, 1999). Each slice was cut with a commercial electric knife (Beko, model BKK2100, Turkey) in order to have a slice thickness of 12.5 mm. For each compression test, two slices from the center of each bread loaf were used. The TPA method were as follows: pre-test speed 1.7 mm/s; test speed 1,7 mm/s; post-test speed 1.7 mm/s; 30% compression, trigger force 5 g, the waiting time between the first and second compression cycle was 5 s.

2.8. Sensory evaluation

Sensory analysis of the bread samples was assessed with a 15-point hedonic scale by 9 untrained panelists. Fresh bread slices of 2 cm thickness were served to the panelists and the scores for crust and crumb color, pore structure, chewiness, taste and general acceptance were rated using a scale of 1: extremely disliked, 5: neither liked nor disliked, 10: liked and 15: extremely liked to determine the general degree of appreciation for the breads (Haglund et al., 1998; Kihlberg et al., 2006).

2.9. Statistical analysis

One-way ANOVA was performed for statistical analysis and Tukey's test was chosen to measure the means of the results with significant differences (P<0.05). Data analysis was conducted using the software package (JMP 9) (Nakov et al., 2018).

3. Results and Discussion

3.1. Total phenolic content, antiradical activity and total fiber

Total fiber, total phenolic contents (TPC) and antioxidant activity of bread enriched with FSB is presented in Table 1. The crust and crumb of bread samples phenolic values varied from 339.55-532.79 mg GAE/g and 125.59-360.72 mg GAE/g, respectively. Additionally, the effect on TPC content with the increase in FSB amount, increasing the fig seed pulp (FSB) percentage from 1% to 7.5%, significantly increased the TPC content of both the bread crust and crumb of bread samples (P<0.05). The FSB content in crust was determined to be higher compared to the crumb of bread samples. Most phenolic compounds, especially anthocyanins, were determined to concentrate in the skins of figs (Dueñas et al., 2008). Figs and fig by-products are a perfect source of minerals, vitamins, phenolics and dietary fiber and contain the three main phenolic groups of phenolic acids, flavonoids and anthocyanins (Solomon et al., 2006; Veberic et al., 2008). A study about the phenolic compounds in figs found different colors (black, red, yellow and green) affected the anthocyanins, polyphenols and flavonoids in skin and pulp, with darker varieties having much higher polyphenols and antioxidant activity compared to pulp (Solomon et al., 2006). A study about the phytochemical properties of Turkish fig varieties and genotypes determined the phenolic content of figs varied according to region with Turkish figs having the richest phytochemical properties (Caliskan, 2015). Figs are accepted as an important fruit variety in the Mediterranean diet as they have antioxidant activity, while they are identified as a symbol of long life around the world (Yang et al., 2009). The antioxidant activity obtained from crust and crumb of bread samples varied from 348.68-817.04 and 190.04-343.64 mg TE/L, respectively.

Additionally, the effect of FSB concentration on radical scavenging activity showed the antioxidant activity significantly increased with the increase in FSB amount from 1% to 7.5% (P<0.05) and FSB content in crusts was determined to be higher compared to the crumb of bread samples. Compared to bread made without FSB, the addition of FSB flour increased the total fiber content of the bread.

3.2. Texture of bread samples

Texture is an important quality characteristic as it has a great influence on the acceptability of the bread (Frisullo et al., 2010). Therefore the TPA parameters were analyzed to determine the effect of the addition of FSB on the textural parameters such as hardness, springiness, cohesiveness, gumminess, chewiness and resilience (Table 2). The addition of increased ratio of FSB from 1% to 7.5% to wheat flour led to a significant increase (p < 0.05) in the hardness values. This may be related to the high dietary fiber content, which is known to alter the texture properties of food product because of possessing the high water absorption capacity, so water does not become available for gluten that is formed while kneading. On the other hand, considering the control sample, adding up to 7.5% FSB had a positive effect on the hardness value. Although the dietary fiber content changes the hardness of bread, these changes are mainly affected by the fiber source. At the same time dietary fiber content in bread is effective on reducing hardness (Kurek & Wyrwisz, 2015). The springiness value expressing the degree of recovery after the force is removed was varied from 0.95 to 1.95%. Highest springiness and cohesiveness values were observed in the 1% and 2.5% FSB breads. Since high springiness values are related with fresh and elastic product,

Table 1. Fiber, phenolic and antioxidant content of bread samples

FSB level (%)	**Fiber content (%)**	**Total phenolic content (mg GAE/g)**		**Radical scavenging activity (mg TE/L)**	
		Crust	**Crumb**	**Crust**	**Crumb**
0	1.06±0.02^{e}	339.55 ± 6.37^{e}	125.59±7.01^{e}	348.68 ± 24.93^{e}	190.04±0.00^{e}
1	3.2±0.01^{d}	430.54 ± 20.39^{d}	150.81±4.46^{d}	431.77 ± 14.24^{d}	222.77±17.81^{d}
2.5	4.6±0.05^{c}	463.42 ± 7.01^{c}	152.16±10.19^{c}	479.67 ± 39.17^{c}	265.58±28.49^{c}
5	5.3±0.03^{b}	532.79 ± 29.94^{b}	280.99±5.10^{b}	615.59 ± 17.81^{b}	305.87±14.24^{b}
7.5	6.2±0.02^{a}	568.83 ± 12.10^{a}	360.72±19.75^{a}	817.04 ± 3.56^{a}	343.64±10.68^{a}

Each value is expressed as mean ± SD (n = 3) and means having different letter superscripts within a same column are significantly different (P < 0.05).(FSB: Fig seed byproduct, %0 control sample)

Table 2. Textural properties of bread samples

FSB level (%)	**Hardness (G)**	**Springiness**	**Cohesiveness**	**Gumminess**	**Chewiness (G)**	**Resilience**
0	304.62±0.6^{b}	0.98±0.0^{b}	0.89±0.0^{a}	235.31±9.6^{b}	360.86±0.3^{ab}	0.55±0.0^{ab}
1	162.61±2.5^{e}	1.95±0.1^{a}	0.89±0.0^{a}	147.07±2.3^{d}	278.52±2.7^{b}	0.55±0.0^{ab}
2.5	245.70±6.3^{d}	1.82±1.11^{a}	0.88±0.0^{ab}	215.38±4.3^{c}	348.02±39.4^{ab}	0.56±0.0^{a}
5	265.58±3.3^{c}	1.11±0.2^{b}	0.86±0.0^{b}	227.44±2.3^{bc}	314.96±15.9^{ab}	0.53±0.0^{b}
7.5	473.51±1.2^{a}	0.95±0.0^{b}	0.86±0.0^{b}	403.14±0.6^{a}	392.35±12.0^{a}	0.55±0.0^{ab}

Each value is expressed as mean ± SD (n = 3) and means having different letter superscripts within a same column are significantly different (P < 0.05). (FSB: Fig seed byproduct, %0 control sample)

3.3. Color values of bread samples

The color features of crust and crumb of samples are given in detail in Table 3. Supplementation of bread by FSB caused differences in both the crust and crumb colors. For each of the groups with additions of different proportions of FSB, the sample with highest bright value was the control group. In bread samples produced with FSB, the *L** value reduced from 77.10 to 59.66 for the crust and from 70.86 to 62.82 for the crumb linked to the increase in additive amount from 0 to 7.5%. With the reduction in seed pulp contribution, the *a** values for crust and crumb were observed to increase. The *a** value for bread crust with 7.5% fig seed pulp was determined as 29.59, while the crumb value was 16.96. For the yellowness value (*b**), the crust color of bread samples with FSB did not vary as the proportion of fig seed pulp increased, while the crumb color was determined to increase as the proportion increased. Bread samples containing 1% FSB had crumb b* value that was statistically similar to the crumb color value for the control group. Brown indices were calculated as 100 *L** in terms of lightness, with a (*L**) value of 100 for white and 0 for black (Liu et al., 2018). Results showed that the crust brown index varied from 29.90 to 41.25, while the brown crumb of bread samples index varied from 29.14 to 37.18. Additionally, the effect of FSB percentage on brown index caused an increase in the brown index with the increase in FSB in the formulation. Therefore, the increase in FSB additive darkened the color of the bread. In a study of the addition of fig seed flour (FSF) to biscuit dough samples, when the proportion rose from 0% to 30%, the *L** value decrease from 77.11 to 43.04, while the *a** value increased from 0.1 to 8.10 in the 30% group (Ulutürk, 2018). For the yellowness value, there was a reduction observed with the increase in FSF added to biscuit dough samples. This study determined that as the FSB proportion increased in bread sample, the crumb of the bread was darker and more yellow.

3.4. Sensory properties of bread samples

The results related to sensory values for breads with FSB supplementation are given in Table 4 and bread samples are shown in Figure 1. Bread samples produced with the addition of FSB did not have a statistical difference for crust color points, while the control 1% and 2.5% FSB-supplemented breads had the most liked crumb color. For bread crumb of bread color points, the 1% and 2.5% FSB breads, control breads and 5% and 7.5% FSB breads were statistically similar. For the hardness of breads, the points fell from 12.23 to 7.6 linked to the increase in the FSB proportion. Assessment in terms of taste identified there was no statistical difference in points for FSB breads and control breads. The general appreciation points for FSB breads varied from 11.25 to 12.45. There was no statistical difference in terms of general acceptability between 1% and 5% FSB breads and these were identified to be the most chosen breads. The lowest acceptance was for the control breads not containing FSB.

Figure 1. Bread samples with fig seed byproduct (FSB) a) Bread with 0% (Control) FSB addition; b) Bread with 1% FSB addition; c) Bread with 2.5% FSB addition; d) Bread with 5% FSB addition

Table 3. Crust and crumb color values of bread samples

FSB level (%)	Crust color				Crumb color			
	*L**	*a**	*b**	Brown index	*L**	*a**	*b**	Brown index
0	70.10±0.31^{a}	9.20±0.15^{c}	24.47±0.31^{b}	29.90^{c}	70.86±0.97^{a}	5.43±0.20^{b}	11.68±0.33^{d}	29.14^{e}
1	67.06±1.80^{ab}	12.82±0.07^{b}	29.10±0.31^{a}	32.94^{b}	68.80±1.21^{ab}	5.50±0.30^{b}	12.17±0.62^{d}	31.20^{d}
2.5	63.89±0.10^{bc}	13.33±0.07^{b}	28.89±0.40^{a}	36.11^{ab}	67.52±1.71^{ab}	5.90±0.13^{ab}	13.53±0.19^{c}	32.48^{c}
5	58.75±0.15^{cd}	15.26±0.20^{a}	28.97±0.52^{a}	40.34^{a}	66.89±0.30^{b}	5.97±0.06^{ab}	15.05±0.03^{b}	33.11^{b}
7.5	59.66±0.24^{d}	15.88±0.23^{a}	29.59±0.32^{a}	41.25^{a}	62.82±0.92^{c}	6.44±0.33^{a}	16.96±0.60^{a}	37.18^{a}

Each value is expressed as mean ± SD (n = 3) and means having different letter superscripts within a same column are significantly different (P < 0.05). (FSB: Fig seed byproduct, %0 control sample)

Table 4. Sensory properties of bread samples

FSB level (%)	Crust color	Crumb color	Pore structure	Chewiness	Taste	General Acceptance
0	11.08±0.33^{a}	12.38±0.63^{a}	13.05±0.45^{a}	12.23±0.98^{a}	13.78±1.03^{a}	11.25±0.78^{b}
1	10.60±0.60^{a}	11.28±0.53^{ab}	12.60±0.40^{a}	12.10±0.10^{a}	12.08±1.33^{a}	13.13±0.13^{a}
2.5	10.83±1.58^{a}	10.75±0.25^{ab}	12.33±0.08^{ab}	9.8±0.0^{b}	11.73±0.48^{a}	13.55±0.05^{a}
5	9.40±0.40^{a}	9.83±0.58^{b}	9.98±0.55^{bc}	9.43±0.18^{bc}	11.43±0.18^{a}	13.40±0.40^{ab}
7.5	9.28±1.53^{a}	10.15±0.65^{b}	8.40±1.40^{c}	7.60±0.60^{b}	10.53±0.28^{a}	12.45±0.25^{c}

Each value is expressed as mean ± SD (n = 3) and means having different letter superscripts within a same column are significantly different (P < 0.05). (FSB: Fig seed byproduct, %0 control sample)

4. Conclusions

In the present study the FSB waste obtained from fig oil production was evaluated to availability for bread production. The results identified that the use of FSB in bread production makes it possible to enrich bread with respect to the fiber and phenolic content. Although the increasing the ratio of FSB in bread led to increase fiber and phenolic content, adding more than 5% caused negative effects on the texture parameters. Likewise, sensory properties especially general appreciation was not affected by adding up to 5% FSB. Therefore, the possible use of by-products obtained from figs in the food industry is thought to have beneficial effect due to the high polyphenolic content. Therefore, it is thought that the addition of FSB to bread at the specified rates both increase the bioactive properties of the bread and be beneficial for the environment in terms of waste evaluation.

Acknowledgments

This study has no fund support and has no conflict of interest with any institution

References

AACC. (1999). AACC Method Approved Methods of Analysis 11th Ed.

Anon, A. (2003). Perception and understanding of health components of bread. *Federation of Bakers,* London, UK,.

Arvaniti, O. S., Samaras, Y., Gatidou, G., Thomaidis, N. S., & Stasinakis, A. S. (2019). Review on fresh and dried figs: Chemical analysis and occurrence of phytochemical compounds, antioxidant capacity and health effects. *Food Research International, 119*, 244-267 https://doi.org/10.1016/j.foodres.2019.01.055.

Baiano, A. (2014). Recovery of biomolecules from food wastes—A review. *Molecules, 19*(9), 14821-14842 doi: 10.3390/moleküller190914821.

Bender, D. A. (2006). *Benders' dictionary of nutrition and food technology*. Woodhead Publishing ISSN 978-1-84569-051-9.

Caliskan, O. (2015). Mediterranean figs (*Ficus carica* L.) functional food properties. In *The Mediterranean Diet* (pp. 629-637). Elsevier doi: 10.1016/B978-0-12-407849-9.00056-7.

Del Caro, A., & Piga, A. (2008). Polyphenol composition of peel and pulp of two Italian fresh fig fruits cultivars (Ficus carica L.). *European Food Research and Technology, 226*(4), 715-719 doi: 10.1007/s00217-007-0581-4.

Dueñas, M., Pérez-Alonso, J. J., Santos-Buelga, C., & Escribano-Bailón, T. (2008). Anthocyanin composition in fig (Ficus carica L.). *Journal of Food Composition and Analysis, 21*(2), 107-115 doi: 10.1016/j.jfca.2007.09.02.

Ergun, Z., & Bozkurt, T. (2020). Determination of fatty acid composition and antioxidant activity of fig seed oil. *International Journal of Agricultural and Natural Sciences, 13*(2), 101-107 Cilt 13 Sayı 2 (2020): IJANS 2020-13-2.

Frisullo, P., Conte, A., & Del Nobile, M. A. (2010). A novel approach to study biscuits and breadsticks using X-ray computed tomography. *Journal of Food Science, 75*(6), E353-E358 doi: 10.1111/j.1750-3841.2010.01689.x.

Haglund, Å., Johansson, L., & Dahlstedt, L. (1998). Sensory evaluation of wholemeal bread from ecologically and conventionally grown wheat. *Journal of Cereal Science, 27*(2), 199-207 doi:10.1006/JCRS.1997.0155.

Hssaini, L., Charafi, J., Hanine, H., Ennahli, S., Mekaoui, A., Mamouni, A., & Razouk, R. (2019). Comparative analysis and physio-biochemical screening of an ex-situ fig (Ficus carica L.) collection. *Horticulture, Environment, and Biotechnology, 60*(5), 671-683https://doi.org/10.1007/s13580-019-00170-4.

Hssaini, L., Hanine, H., Charafi, J., Razouk, R., Elantari, A., Ennahli, S., Hernández, F., & Ouaabou, R. (2020). First report on fatty acids composition, total phenolics and antioxidant activity in seeds oil of four fig cultivars (*Ficus carica* L.) grown in Morocco. *OCL, 27,* 8 https://doi.org/10.1051/ocl/2020003.

Ignat, I., Volf, I., & Popa, V. I. (2011). A critical review of methods for characterisation of polyphenolic compounds in fruits and vegetables. *Food Chemistry, 126*(4), 1821-1835 https://doi.org/10.1016/j.foodchem.2010.12.026.

Jeong, W. S., & Lachance, P. (2001). Phytosterols and fatty acids in fig (Ficus carica, var. Mission) fruit and tree components. *Journal of Food Science, 66*(2), 278-281 https://doi.org/10.1111/j.1365-2621.2001.tb11332.x.

Kamiloglu, S., & Capanoglu, E. (2013). Investigating the in vitro bioaccessibility of polyphenols in fresh and sun-dried figs (*Ficus carica* L.). *International Journal of Food Science & Technology, 48*(12), 2621-2629 doi: 10.1111/ijfs.12258.

Karaman, S., Karasu, S., Tornuk, F., Toker, O. S., Gecgel, U., Sagdic, O., Ozcan, N., & Gul, O. (2015). Recovery potential of cold press byproducts obtained from the edible oil industry: physicochemical, bioactive, and antimicrobial properties. *Journal of Agricultural and Food Chemistry, 63*(8), 2305-2313 doi: 10.1021/jf504390t.

Kihlberg, I., Öström, Å., Johansson, L., & Risvik, E. (2006). Sensory qualities of plain white pan bread: Influence of farming system, year of harvest and baking technique. *Journal of Cereal Science, 43*(1), 15-30 doi: 10.1016/j.jcs.2005.04.008.

Kumar, K. (2020). Nutraceutical potential and utilization aspects of food industry by-products and wastes. In *Food Industry Wastes* (pp. 89-111). Elsevier https://doi.org/10.1016/B978-0-12-817121-9.00005-X.

Kurek, M., & Wyrwisz, J. (2015). The application of dietary fiber in bread products. *Journal of Food Processing and Technology, 6*(5), 447-450 doi: 10.4172/2157-7110.1000447.

Liu, S., Chen, D., & Xu, J. (2018). The effect of partially substituted lupin, soybean, and navy bean flours on wheat bread quality. *Food and Nutrition Sciences, 9*(07), 840 doi: 10.4236/fns.2018.97063.

Matos, M. E., & Rosell, C. M. (2012). Relationship between instrumental parameters and sensory characteristics in gluten-free breads. *European Food Research and Technology, 235*(1), 107-117 doi: 10.1007/s00217-012-1736-5.

McCleary, B. V., Sloane, N., Draga, A., & Lazewska, I. (2013). Measurement of total dietary fiber using AOAC Method 2009.01 (AACC International Approved Method 32-45.01): evaluation and updates. *Cereal Chemistry, 90*(4), 396-414 https://doi.org/10.1094/CCHEM-10-12-0135-FI.

Mirabella, N., Castellani, V., & Sala, S. (2014). Current options for the valorization of food manufacturing waste: a review. *Journal of Cleaner Production, 65*, 28-41 https://doi.org/10.1016/j.jclepro.2013.10.051.

Morales-de La Pena, M., Rábago-Panduro, L., Martín-Belloso, O., & Welti-Chanes, J. (2021). Challenges and Benefits of Using Pecan Kernels, Derivatives, and Byproducts as Alternative Ingredients in Food Product Development. *Food Reviews International*, 1-13 doi: 10.1080/87559129.2021.1961269.

Nakov, G., Brandolini, A., Ivanova, N., Dimov, I., & Stamatovska, V. (2018). The effect of einkorn (Triticum monococcum L.) whole meal flour addition on physico-chemical characteristics, biological active compounds and in vitro starch digestion of cookies. *Journal of Cereal Science, 83*, 116-122 doi: 10.1016/j.jcs.2018.08.004.

Quideau, S., Deffieux, D., Douat-Casassus, C., & Pouysegu, L. (2011). Plant polyphenols: chemical properties, biological activities, and synthesis. *Angewandte Chemie International Edition, 50*(3), 586-621 doi: 10.1002/anie.201000044.

Rakha, A., Åman, P., & Andersson, R. (2013). Fibre-enriched and wholegrain breads. in *Fibre-rich and wholegrain foods: improving quality*, (pp. 211-235) Woodhead Publishing, doi: 10.1533/9780857095787.3.211.

Routray, W., & Orsat, V. (2019). Agricultural and Food Industry By-Products: Source of Bioactive Components for Functional Beverages. In *Nutrients in Beverages* (pp. 543-589). Elsevier https://doi.org/10.1016/B978-0-12-816842-4.00015-0.

Schmitzer, V., Slatnar, A., Mikulic-Petkovsek, M., Veberic, R., Krska, B., & Stampar, F. (2011). Comparative study of primary and secondary metabolites in apricot (Prunus armeniaca L.) cultivars. *Journal of the Science of Food and Agriculture, 91*(5), 860-866 doi: 10.1002/jsfa.4257.

Singh, R., Chidambara Murthy, K., & Jayaprakasha, G. (2002). Studies on the antioxidant activity of pomegranate (Punica granatum) peel and seed extracts using in vitro models. *Journal of Agricultural and Food Chemistry, 50*(1), 81-86 doi: 10.1021/jf0255735.

Singleton, V. L., & Rossi, J. A. (1965). Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. *American Journal of Enology and Viticulture, 16*(3), 144-158 Corpus ID: 86645261.

Solomon, A., Golubowicz, S., Yablowicz, Z., Grossman, S., Bergman, M., Gottlieb, H. E., Altman, A., Kerem, Z., & Flaishman, M. A. (2006). Antioxidant activities and anthocyanin content of fresh fruits of common fig (Ficus carica L.). *Journal of Agricultural and Food Chemistry, 54*(20), 7717-7723, https://doi.org/10.1021/jf060497h.

Tekin-Cakmak, Z. H., Karasu, S., Kayacan-Cakmakoglu, S., & Akman, P. K. (2021). Investigation of potential use of by-products from cold-press industry as natural fat replacers and functional ingredients in a low-fat salad dressing. *Journal of Food Processing and Preservation*, e15388 https://doi.org/10.1111/jfpp.15388.

Ulutürk, Ş. (2018). *İncir çekirdeği unu kullanılarak glutenli ve glutensiz bisküvi üretimi*. Master Thesis, Institute of Science, Suleyman Demirel University, Isparta, Turkey.

Veberic, R., Colaric, M., & Stampar, F. (2008). Phenolic acids and flavonoids of fig fruit (*Ficus carica* L.) in the northern Mediterranean region. *Food Chemistry, 106*(1), 153-157 https://doi.org/10.1016/j.foodchem.2007.05.061.

Veberic, R., Jurhar, J., Mikulic-Petkovsek, M., Stampar, F., & Schmitzer, V. (2010). Comparative study of primary and secondary metabolites in 11 cultivars of persimmon fruit (Diospyros kaki L.). *Food Chemistry, 119*(2), 477-483 http://dx.doi.org/10.1016/j.foodchem.2009.06.044.

Wongwaiwech, D., Weerawatanakorn, M., & Boonnoun, P. (2020). Subcritical dimethyl ether extraction as a simple method to extract nutraceuticals from byproducts from rice bran oil manufacture. *Scientific Reports, 10*(1), 1-10 https://doi.org/10.1038/s41598-020-78011-z.

Yang, X.-m., Yu, W., Ou, Z.-p., Liu, W.-m., & Ji, X.-l. (2009). Antioxidant and immunity activity of water extract and crude polysaccharide from Ficus carica L. fruit. *Plant Foods for Human Nutrition, 64*(2), 167-173 doi: 10.1007/s11130-009-0120-5.

Yeganehzad, S., Kiumarsi, M., Nadali, N., & Ashkezary, M. R. (2020). Formulation, development and characterization of a novel functional fruit snack based on fig (*Ficus carica* L.) coated with sugar-free chocolate. *Heliyon, 6*(7), e04350 https://doi.org/10.1016/j.heliyon.2020.e04350.