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EFFECT OF OLIVE STONE POWDER AS A VALUABLE SOURCE OF BIOACTIVE MOLECULES ON YOGHURT

BIYOAKTIF MOLEKÜLLERIN DEĞERLI BIR KAYNAĞI OLAN ZEYTIN ÇEKIRDEĞI TOZUNUN YOĞURT ÜZERINE ETKISI

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ÖZET

Gıda endüstrisinde atık kullanımı, tüm dünyada en çok önem verilen konulardan biridir. Gıdaların atık maddelerinden daha ileri endüstriyel prosesler için faydalanılabilir. Zeytin çekirdekleri, zeytin endüstrisinde üretilen atıkların çoğunu oluşturmaktadır ve zeytin çekirdeklerinin tüketimi veya daha ileri kullanım için değerlendirilme olanakları üzerinde durulmamaktadır. Bu çalışmada, zeytin meyvelerinin atık ürünleri olan zeytin çekirdeklerinin kullanım olanakları araştırılmıştır. Bu amaçla zeytin çekirdeği yoğurda farklı oranlarda katılarak yoğurdun protein, lif, kül ve yağ, toplam fenol ve antioksidan özlliklerindeki değişim incelenmiştir. Zeytin tozu çekirdeği yoğurtların lif ve toplam fenolik madde içeriklerinde istatistiksel olarak önemli bir artış sağlamıştır ($p<0.05$). Sonuçta, zeytin çekirdeklerinin gıda endüstrisi için çekici ve sağlıklı bir bileşen olabileceği sonucuna ulaşılmıştır.

Anahtar Kelimeler: atık yönetimi, zeytin çekirdeği, ham lif, yoghurt, antioksidanlar

ABSTRACT

Waste utilization in food industries is one of the most substantial issues all over the world. Waste materials of foods can be utilized for further industrial process. The stones of olives comprise the majority of the waste produced in the olive fruit industry and they are not evaluated for consumption or further use. In this study, the utilization possibilities of olive stones which are waste products of olive fruits were investigated. For this aim, the changes in protein, fiber, ash, fat, total phenolic and antioxidant properties of yogurt was investigated by adding olive seed to the yogurt in different proportions. Olive stone powder increased the fiber and total phenolic contents of yoghurt samples ($p <0.05$). Therefore, it was concluded that the stones of olives could be used as a healthy ingredient for food industry.

Keywords: waste utilization, olive stone, fiber, yoghurt, antioxidants,

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INTRODUCTION

Waste in the food processing industry means a high volume of product-specific waste (Russ & Meyer-Pittroff, 2004). The processing of food materials generates huge quantities of waste and by-products (Topkaya & Isik, 2019). The food processing industries have grown rapidly all over the world and waste materials of foods occur

during all phases of the process including harvesting, transporting, classification, storing, marketing, and at home before or after preparation. These huge quantities of wastes also contribute to serious environmental problems (Vilariño et al., 2014). The problem of industrial waste is soaring day by day. In order to exploit waste, much more effort is needed. However, wastes of foods are suitable for consumption, but they are not consumed (FAO 2014). Furthermore, the waste materials of foods can be used as a source of flavors, dietary fiber and protein (Zheng & Shetty, 1998).

The olive, known by the botanical name *Olea europaea*, is the fruit of the olive tree and belongs to the family *Oleaceae* (Owen et al., 2000). The olive fruit, olive oil, and the leaves of the olive tree are used traditionally for medicinal purposes (Soni et al., 2006). Olives are a staple in the healthy Mediterranean diet, so they attract research attention on their health benefits. In the Mediterranean region, 90% of olives are used to make olive oil which widely used in frying and cooking of foods or as a salad dressing. It is also used in pharmaceuticals, cosmetics, and as a fuel for traditional oil lamps. Various studies were conducted related to the olive, olive oil and the leaves of olive tree (Beltrán et al., 2016; Bulotta et al., 2014; Cicerale et al., 2008; Covas et al., 2009; Esposto et al., 2015; Kachouri et al., 2015; Xiang et al., 2017; Yanık, 2017). On the other hand, not many studies were conducted pertaining to olive stone, which contains many important nutritional components such as protein fat and polyols. Moreover, stones of olives are rich source of cellulose, hemicellulose, and lignin (Rodríguez et al., 2008). High-fibre products containing hemicellulose, cellulose and lignin have many positive effects on human health (Sudha et al., 2007). However, the olive stones are not considered suitable for consumption or alternative use. Since olive stone is rich in bioactive compounds (Nunes et al., 2016), the utilization of olive stone may increase the economic value of this waste product. Determining the potential use of this waste products as a nutrition source may also provide many health benefits.
Yoghurt is one of the most popular fermented foods and it is rich source of vitamins, mineral and protein (Das et al., 2019), but these components are reduced since they are utilized by the bacterial culture used to produce the yogurt. Enrichment of yoghurt could be an alternative to including healthy foods in the human diet.
Therefore, the aim of this study was to determination of chemical composition of olive stone and investigation of its utilization in producing enriched yoghurt.

MATERIALS and METHODS

Materials

Stones of Çelebi variety olives (approximately 100 kg) were used in this study. The olives harvested 12-year-old olive garden located in Bursa, Turkey on 18 October 2018 and they were stored at -18 °C. The stones were removed from olive fruit manually.

Preparation of Olive Stone Powder

After 5 min boiling, the olive fruits were pulped by manual crushing. Then, the olive stones were dried using a dryer (Retsch-TG 100, Germany) at 60 °C for 30 min. The stones of olives were milled using a laboratory mill (MLU-202, Bühler) with particle size of 150 µm.

Preparation of Yoghurt Samples

Firstly, the cow's milk was pasteurized at 90°C for 5 minutes. Then, the milk was cooled to 45°C and it was inoculated with the 0.02% (w/v) starter culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* for all samples. The inoculated yoghurt samples were transferred over the olive stone powder which was previously dosed directly into the yogurt jars in proportions of 4%, %8 and 12%, after a vigorous stirring for the uniform distribution of the starter culture. The fermentation process was conducted at 43°C, until a pH of 4.6 was reached. Then the finished yoghurt samples were stored at 4°C for the next 24 h.

Proximate Analysis

The proximate analysis of olive stones was performed based on the method AOAC (2005) including total protein, fat, ash, crude fiber.

Determination of Total Phenolic Content

Total phenolic contents of olive stones and yoghurt samples were measured by Folin and Ciocalteu method (Gutfinger, 1981). 0.1 ml diluted extract was added to 0.4 ml methanol. Then 3 ml of distilled water was added to the mixture. The mixture was shaken vigorously followed by addition of 0.5 ml of Folin–Ciocalteu reagent. After waiting 3 min, 1 ml of saturated (35%, w/v) sodium bicarbonate solution was added. The mixture was incubated for 60 min in dark and the absorbance was measured by a UV-VIS spectrophotometer at 725 nm. The results were expressed as mg of gallic acid equivalent.

Determination of Antioxidant Activity (DPPH) Assay

The antioxidant activity of olive stones and yoghurt samples were determined by the 1,1-diphenyl-2-picryl-hydrazyl (DPPH) assay (Singleton et al., 1999). Two ml DPPH radical were mixed the extract solution at different concentrations. The mixtures were incubated in the dark for 30 min. The absorbance of the mixture was then measured against a blank solution with a UV-VIS spectrophotometer at 517 nm. The ability of the sample to scavenge DPPH scavenge was calculated by the following equation:

DPPH Scavenging Activity (%) = (Ac-At)/Ac x 100

- Ac: Absorbance of the control
- At: Absorbance of the sample solution

RESULTS and DISCUSSION

Proximate Compositions

As seen in Table 1, the stones of olives are rich source of crude fiber (74.8 %). Results of many studies have revealed that adequate fiber intake has several health benefits including decreased risk of cardiovascular disease, hypertension, Tip-2 diabetes, obesity, and colon cancer (Marlett, McBurney, & Slavin, 2002; Post, Mainous, King & Simpson, 2012). Moreover, eating a diet high in fiber boosts immune system and overall health (Schley & Field, 2002). Many fiber enriched food formulations have been developed. Sendra et al. (2010) enriched yoghurt with orange fiber. Besbes, Attia, Deroanne, Makni & Blecker (2008) enriched meat with pea fiber. Fu, Chang & Shiau (2015) enriched bread with lemon fiber. Parveen, Bajpai, Bhatia & Singh (2017) enriched biscuits with carrot and beetroot pomace fiber. Fiber sources are many important to develop healthy food formulations. As seen in Table 1, enrichment of yoghurt with olive stone powder increased the crude fiber content of yoghurt samples significantly ($p<0.05$). Therefore, thanks to its high fiber content, the olive stones could be a cheap and healthy fiber source for enriched food formulations.

Table 1. Proximate Composition of Olive Stones and Yoghurt Samples (wet basis)

	Total Protein (%)	Crude Fiber (%)	Ash (%)	Fat (%)
Olive Stone	3.20 ± 0.03	74.08 ± 0.07	0.48 ± 0.05	5.50 ± 0.02
Yoghurt (Control)	2.75 ± 0.12^{a}	0.18 ± 0.01^{d}	1.40 ± 0.02^{a}	1.57 ± 0.18^{a}
Yoghurt (4%)	2.90 ± 0.08^{a}	3.12 ± 0.03^{c}	1.28 ± 0.01^{a}	1.88 ± 0.11^{a}
Yoghurt (8%)	3.05 ± 0.04^{a}	5.61 ± 0.05^{b}	1.22 ± 0.01^{a}	1.95 ± 0.08^{a}
Yoghurt (12%)	3.12 ± 0.04^{a}	7.82 ± 0.08^{a}	1.18 ± 0.02^{a}	2.20 ± 0.08^{a}

Mean±S.D., n=3. Means with same letters in the same column are not-significantly different at $p<0.05$

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Protein, ash, fat content of olive stones are given in Table 1. They are present in considerable quantities. Having high nutritional value, proteins are macronutrients which have crucial role in nutrition. Currently, the consumers are more anxious about their health and are starting to realize the correlation between health and diet. Finding new protein sources of protein is very important for the food industry because the trend is towards vegetarianism. Vegans and vegetarians meet their daily protein requirements with vegetable protein, obtained from many types of food, from soy and cereal to nuts and beans. Olive stone can be used for a source of herbal protein. On the other hand, being rich source of fat olive stone powder can contribute fat content of food formulations. The metabolism needs fats for obtaining energy and also utilizes them to synthesize hormones. On the other hand, fats are the most energy-efficient form of food. As seen in Table 1, olive stone powder increased non-significantly total protein, ash, and fat content of yoghurt samples ($p>0.05$).

Antioxidant Activity and Total Phenolic Contents

Phenolics are associated with many health benefits thanks to their prominent antioxidant activities (Setyaningsih, Saputro, Palma, & Barroso, 2016). Majority of the phenolic compounds react with free radicals to prevent biomolecules. (Oliveras-López et al., 2014). When free radicals build up in a person's blood, they can create oxidative stress. Oxidative stress can increase the risk of developing heart disease, cancer, and many other chronic illnesses and health problems (Devasagayam et al., 2004). A diet rich in antioxidants may reduce the risk of various diseases, including coroner heart disease and certain cancers (Jiang & Xiong, 2016). Antioxidants scavenge free radicals from the body cells and prevent the damage caused by oxidation. Many antioxidant sources were used for enrichment of food formulations. Gawlik-Dziki et al. (2013) enriched bread with dry onion. Addition dry onion to the food formulation caused significant improvement of antioxidant abilities of bread samples. Świeca, Sęczyk, Gawlik-Dziki, & Dziki (2014) enriched bread with quinoa leaves. In the result of this study total phenolic content of bread was improved significantly ($p<0.05$).

Table 2. Antioxidant Activity and Total Phenolic Contents of Olive Stones and Yoghurt Samples

	Total Phenolic Content mg GAE/100 g	**Antioxidant Activity Inhibition %**
Olive Stone	1100.34 ± 0.22	14.11 ± 0.03
Yoghurt (Control)	26.15 ± 0.28^{d}	22.41 ± 0.08^{a}
Yoghurt (4%)	35.12 ± 0.12^{c}	24.51 ± 0.05^{a}
Yoghurt (8%)	42.08 ± 0.16^{b}	25.36 ± 0.04^{a}
Yoghurt (12%)	53.12 ± 0.14^{a}	28.32 ± 0.07^{a}

Mean±S.D., n=3. Means with same letters in the same column are not-significantly different at $p<0.05$

The total phenolic content and antioxidant activity of stones of olives and yoghurt samples are shown in Table 2. Addition of olive stone powder increased the total phenolic content and antioxidant activity of yoghurt samples.

CONCLUSION

Waste utilization in food processing industries is one of the most important issues all over the world. The stones of olives comprise the majority of the waste produced in the olive fruit industry and they are not evaluated for consumption or further use. The results of this study revealed that stones of olives contain a significant quantity (74.8%) of crude fibre, which provides a unique feature to be a source of fibre for many enriched food formulations such as bakery and fermented products. Enrichment of yoghurt samples with olive stone powder increased the nutritional properties. The results of this study revealed that owing to their high antioxidative properties and phenolic contents, the olive stones have a great potential to be healthy ingredient for functional food industry. Future studies could be planned with different proportions of olive stone powder on various food materials.

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