arastirma.tarimorman.gov.tr/bursagida
Gıda ve Yem Bilimi - Teknolojisi Dergisi / Journal of Food and Feed Science - Technology 22: 45-53 (2019/2) ISSN 1303-3107

Türkiye'de Meyve ve Sebze Atıklarının Değerlendirilmesi İçin Alternatif Yöntemler

Alternative Techniques For Fruit and Vegetable Waste Valorization in Turkey

Banu AKGÜN[1], Nurcan AYŞAR GÜZELSOY[2], Arzu YAVUZ[3], Yıldıray İSTANBULLU[4], Ahmet BUDAKLIER[5]

[1] *Food Eng. M.sc., Central Research Institute Food and Feed Control, BURSA, TURKEY-**ORCID ID: 0000-0001-7451-7174***
[2] *Food Eng. M.sc., Central Research Institute Food and Feed Control, BURSA, TURKEY-**ORCID ID: 0000-0002-6843-6076***
[3] *Food Eng. M.sc., Central Research Institute Food and Feed Control, BURSA, TURKEY-**ORCID ID: 0000-0002-2526-4761***
[4] *Food Eng. M.sc., Central Research Institute Food and Feed Control, BURSA, TURKEY-**ORCID ID:0000-0001-5336-2580***
[5] *Food Eng., General Directorate of Agricultural Research and Policies, ANKARA, TURKEY-**ORCID ID:0000-0001-5899-9345***

Geliş Tarihi : 29.04.2019
Kabul Tarihi : 01.07.2019

Abstract

Objective: Food loss and waste is a challenge that all countries have to face. Food waste may cause both environmental and economic problem if it is not managed properly; however, it can meet various demands of a country if it is used as a resource. Turkey is a large producer of many fruits and vegetables (e.g. tomatoes, figs, cherries and grapes), and accordingly, solid wastes of these agricultural products constitute an important part of total wastes in Turkey as in other European (EU) countries. Therefore, a proper agricultural waste management system should be designed and used in order to achieve a circular economy. Experts recommend that agricultural wastes should be utilized for obtaining animal feed, composting material, energy and bioactive compounds or feeding people in need instead of throwing them. The aim of this study is to summarize potential solutions to agricultural food waste problem in Turkey based on scientific literature.

Materials and Methods: In this article, alternative methods for fruit and vegetable waste valorization have been reviewed.

Results: The significant amount of fruit-vegetable wastes have been produced in Turkey.

Conclusion: It is more preferable to valorize agri-food wastes by extracting valuable bioactive compounds, producing energy or feeding animals instead of disposing them.

Keywords: Fruit and Vegetable Waste, Waste Valorization Techniques, Waste Management

Özet

Amaç: Gıda kaybı ve israfı, tüm ülkelerin yüzleşmesi gereken bir sorundur. Gıda atıkları, uygun şekilde yönetilmezse çevresel ve ekonomik sorunlara neden olabilirler; öte yandan kaynak olarak kullanılabilirlerse bir ülkenin çeşitli eksiklerini tamamlayabilirler. Türkiye, birçok meyve ve sebzenin (örneğin domates, incir, kiraz ve üzüm) büyük bir üreticisidir ve bu tarımsal ürünlerin katı atıkları, diğer Avrupa (AB) ülkelerinde olduğu gibi, Türkiye'deki toplam atıkların önemli bir bölümünü oluşturur. Bu nedenle, dairesel bir ekonomiye ulaşmak için uygun tarımsal atık yönetim sistemi tasarlanmalı ve kullanılmalıdır. Uzmanlar, tarımsal atıkların atılması yerine hayvan yemi, kompost materyali, enerji veya biyoaktif bileşikler elde etmek ya da ihtiyacı olan insanları beslemek için kullanılması gerektiğini belirtmektedir. Bu çalışmanın amacı, Türkiye'deki tarımsal gıda atıkları problemine olası çözümleri literatür verileri ışığında derlemektir.

Materyal ve Yöntem: Bu makalede, meyve ve sebze atıklarının değerlendirilmesi için alternatif yöntemler gözden geçirilmiştir.

Bulgular: Türkiye'de önemli miktarda meyve-sebze atığı üretilmektedir.

Sonuç: Tarım ürünleri atıklarını, değerli biyoaktif bileşenleri ekstre etmek, enerji üretmek veya hayvan beslemek yoluyla değerlendirmek onları atmaktan daha fazla tercih edilmelidir.

Anahtar Kelime: Sebze ve Meyve Atıkları, Atık Değerlendirme Yöntemleri, Atık Yönetimi

1.Introduction

According to FAO, an estimated one-third of all food produced for human consumption is lost or wasted globally (Anonymous, 2019a). Food losses and waste may occur at every stage in the supply chain. Pre-harvest losses mainly stem from the ineffective use of appropriate technologies and inputs at the production stage, adverse climatic conditions and untimely culturing practices. On the other hand, post-harvest losses may appear in the stage of transport, storage, processing, packaging, marketing and consumption (Tatlıdil et al. 2013). It has been observed that losses occur in the post-harvest stages are relatively higher than pre-harvest losses (Anonymous 2016). Food waste not only causes food scarcity but also causes negative environmental impacts such as the unnecessary release of greenhouse gases (Salihoğlu et al. 2018). In the European Union (EU), food waste is expected to rise to about 126 million tonnes a year by 2020 unless action is taken to cease this trend (Black and Michalopoulos 2017). Hence, preventing food losses should be of the utmost priority for each country.

By considering environmental, social and economic impacts of wastes, food waste specialists proposed a framework to identify the most appropriate options for the prevention of food waste. The Food Waste Pyramid prioritizes actions that organizations can take to prevent and divert wasted food (Figure 1). This pyramid suggests that a reduction, through minimization of food surplus and avoidable food waste, is the most attractive option. The second most preferred option involves feeding people affected by food poverty, followed by the option of converting food waste to animal feed. The fourth option is to compost or to use as a renewable energy resource, and disposal emerges as the least preferred option (Papargyropoulou et al. 2014).

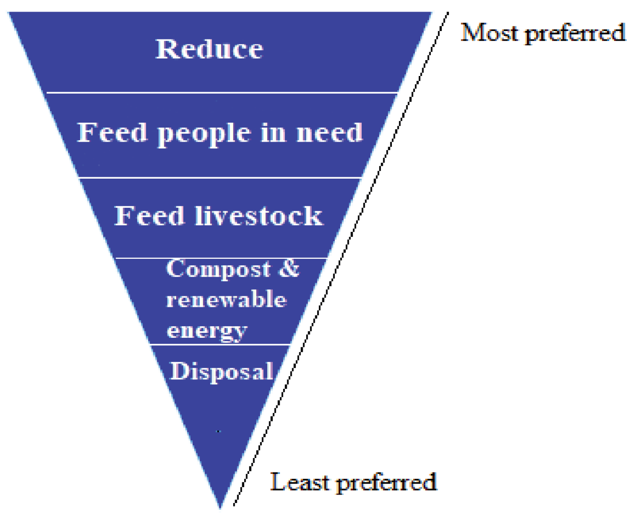

Figure 1. Food waste pyramid (Lovrenčić et al. 2017).

Turkey is a big country with a population of over 80 million people (Anonymous 2019b). The population of Turkey is increasing and the ever-increasing consumption creates larger amounts of waste materials, which affects adversely the environment and human health (Gören and Özdemir 2011). Luckily, there is no problem related to food availability in Turkey; nevertheless, the large amounts of food waste produced is a challenge (Salihoğlu et al. 2018). Fruits and vegetables (by weight) represent 44% of total food wasted (an estimated 1,3 billion tonnes globally), followed by roots and tubers (20%) (Anonymous 2017a).

Turkey is the world's leading producer of many fruits and vegetables like tomatoes, peppers, green beans, citrus fruits (e.g. orange, mandarin, lemon), grapes, cherry and figs (Anonymous 2018a) and these agricultural products may lead to considerable amount solid wastes (10-50%) (Yurdagel et al. 1997). Thus, the evaluation of agricultural solid wastes with the help of different techniques is very important to achieve a circular economy. In this study, information related to the basic methods of agricultural waste management will be reviewed.

2.Fresh fruit and vegetable production in Turkey and wastes

Vegetal production is the leading sector of Turkish agriculture. According to the Turkish Statistical Institute (TUIK), around 45% of Turkey's total vegetative production is obtained from the fruit and vegetable sector (Anonymous 2017b).

Tomato is one of the most crucial vegetable crop for Turkey. World tomato production is about 163 million tons and tomato production in Turkey constitutes an important part of this production. In 2017, 12,7 million tons of production (8,2 million tons of table tomatoes and 4,5 million tons of tomatoes for sauce) made tomatoes the most produced vegetable in Turkey (Table 1) and Turkish tomato production is predicted to continue increasing (Anonymous 2018a). Type of fruit usage, harvesting type, marketing process (marketplace, market, greengrocer) and post-harvesting technologies play an important role in the amount of loss observed in tomato production. The life of tomatoes after harvesting depends on when they are harvested (maturity level). The most widely used index of tomato maturity is skin colour. Distinct changes in external colour occur in tomato fruit which can be used to determine harvest maturity. The ripening stages of mature tomato fruit are categorized as a green, breaker, turning, pink, light red, and red (Takizawa et al. 2014) (Figure 2). For maximal shelf life, tomatoes should be picked at the mature-green stage since red tomatoes will be more susceptible to bruising and injury during harvest and postharvest handling (Anonymous n.d.). Tomato industry can generate a large amount of waste as skins, pulp and seeds (2,5-3,0% by weight of raw material) for which there is often no proper management. On the other hand, it is possible to obtain valuable bioactive ingredients that are extracted from tomato skins and seeds: fiber, lycopene and oils (Anonymous 2018b).

Table 1. Fresh fruits & vegetables production in Turkey in 2017 (Anonymous 2018a).

Products	Amount (Tons)
Tomatoes	12750000
Grapes	4200000
Apples	3032000
Oranges	1950000
Apricot	985000
Cherries	627000
Figs	315000

Figure 2. Ripening stages of mature tomato fruit; from left to right: green, breaker, turning, pink, light red, red.

During the processing of grapes, a substantial amount of solid waste is produced. Due to its richness in terms of mineral content, small wine producers use these wastes in the vineyards as a fertilizer. The pulp of grape contains valuable substances such as fiber (17-21%), tannins (16-27%), polyphenolic compounds (2-6,5%), lipids (7-12%), sugars (3%) and tartaric acid. The main extractive bioactive components of grape residues are polyphenols (Anonymous 2018b). İnal (2010) showed that ground grape marc mixed with organic and inorganic compounds offered more suitable root environment for seedling cultivation. Similarly, Mikar (2011) found that inorganic, organic materials and trace elements added to grape marc created suitable medium to cultivate lettuce.

Large amounts of cherry seeds are discarded at processing plants, which creates an important disposal problem for the food industry. Today there is no systematic collection and utilisation of this material; hence, a valuable product with a large industrial potential remains unexploited. On the other hand, these seeds and other cherry wastes like petioles and leaves can be used for different purposes (Popa et al. 2011).

Fig has a high nutritional capacity and antioxidant qualities that capable of preventing diseases and obesity. It has high carbohydrate content and is rich in fiber, vitamin C, provitamin A, vitamin B and minerals. Thus, the discards of figs contain a large amount of sugar, vitamins, polyphenols, minerals and fiber (Anonymous 2018b).

3.Traditional uses of agricultural wastes

The quick elimination of wastes and by-products is desired by companies. This situation brings some alternative solutions such as using as an animal feed or depositing in a landfill. The first option is usually the most used since the waste is removed by the breeders without demanding an additional cost from the company. However, depositing in a landfill caused an expense. On rare occasions, waste is destinated for recycling by systems such as composting. Some companies incinerate their by-products of agri-food, which leads to the emission of environmental pollutants and greenhouse gases that have a great environmental impact and involve significant costs and risks for public health. Thus, it is necessary to select the best alternatives for valuation of such wastes (Anonymous 2018b).

4.Extraction of bioactive compounds

Food wastes obtained from fruits, vegetables, cereal and other food processing industries can be used as potential source of bioactive compounds through significantly improved extraction process of components such as dietary fibers, phenolics, proteins, sugars, starches, minerals, vitamins, pigments, favour compounds, essential oils, and organic acids (Baiano 2014, Virot et al. 2010). Objective of the extraction is the use of organic by-products to obtain natural compounds with high added value for the food, cosmetic or pharmaceutical industry. Many of these compounds have beneficial health attributes: antimicrobial, antiviral, antioxidant, anticancer, anti-inflammatory, and anti-diabetes (Shahidi and Yeo 2018).

Numerous studies have been carried out for isolation, quantification, and characterization of phenolic compounds, dietary fibers, and other bioactive compounds in different fruits and vegetables. Bioactive compounds from plant materials can be extracted by various extraction techniques. Conventional extraction methods like steam distillation, solvent extraction, acid, alkali extraction, and novel extraction methods like super-critical fluids, microwaves, sonication, and enzyme-assisted extraction methods can be used to obtain the highest yield of target bioactive compounds (Meireles 2008, Sagar et al. 2018). Some of the novel extraction techniques are considered as green techniques and include less hazardous chemical synthesis; designing safer chemicals, safe solvents auxiliaries. However, all techniques may have advantages or disadvantages related to nature of plant matrix and chemistry of target compounds so all alternative extraction methods should be evaluated before selecting the most appropriate technique to recover value-added products from plant materials (Azmir et al. 2013).

Many fruits and vegetables such as bananas, apples, tomatoes, lettuce, sweet peppers, pears, grapes, onions, artichokes, and asparagus produce significant amounts of waste. Tomatoes are processed to produce tomato juice, paste, purée, ketchup, canned tomatoes and many other food products. Tomato industries produce large amounts of wastes and during tomato processing, these wastes are mainly obtained in the form of seeds, skin and also fibrous parts. Both fresh and processed tomato waste possesses high nutritional value due to its content of vitamins, folates, carotenoids and phenolic compounds (Savatović et al. 2010).

This residue is a good source of lycopene which is coloring material and used commercially in the feed, food, nutraceutical and pharmaceutical industries (Baysal et al. 2000, Nour et al. 2018) Numerous studies have been carried out on the extraction of lycopene from tomato waste. Baysal et al. (2000) investigated process conditions during the extraction of coloring materials from tomato paste waste with supercritical carbon dioxide extraction while Nobre et al. (2012) showed that supercritical ethane and near critical mixture of ethane and propane have better solvent properties than supercritical CO_2, leading to a faster extraction and higher recovery of the carotenoid. Elbadrawy and Sello (2016) investigated he potential nutritive value of tomato peel and they found that it has good nutritional value because of its content of essential amino acids and fatty acids besides its high content of antioxidants such as flavonoids, phenolic acids, lycopene, ascorbic acid and minerals.

Grape is another important fruit which can be consumed as fresh fruit, juice or dietary products. Also, several products such as wine, raisins, jam and jelly can be derived from grapes. During processing, grape can lead to huge amounts of wastes, including grape peels, stems and seeds which contain bioactive compounds such as flavonols, flavanols, anthocyanins, and resveratrol (Barcia et al. 2014, Cadiz-Gurrea et al. 2017). Grape peels and seeds have phenolic and flavonoid constituents including gallic acid, cyanidin-3-glucoside, epicatechin, catechin gallate, ferulaic acid, rutin and resveratrol, which could contribute to the antioxidant capacities of these grape peels and seeds (Tang et al. 2018). Several studies have been carried out to investigate different extraction techniques in grape waste. Pintac et al. (2018) investigated the efficacy of six solvents for the extraction of polyphenolic and triterpenoid compounds and found that EtOAc was the best for obtaining an extract rich in polyphenols and acidified 50% MeOH for isolation of anthocyanins. The unripe grape extracts from agro-industrial wastes derived from the wine industry which are rich in flavan-3-ols have antifungal activity against both Candida and dermatophytes and could be used as antifungal agents in many fields and as a cheap source of value-added products (Simonetti et al. 2017).

Cherry fruits are cultivated worldwide and have great popularity due to rich refreshing flavor and recognized health benefits. According to the available literature, cherry fruit, petiols and leaves are a good source of bioactive compounds. The leaves and petioles have a higher concentration of polyphenols (coffee acid, chlorogenic acid, p-coumaric acid, and myricetin) as well as an antioxidant activity than the fruit. The fruit part can be characterized by the presence of total anthocyanins. Due to the high antioxidants level, the leaves and petioles can be a potential source to produce functional food (Dziadek et al. 2019). Subcritical water extracts of cherry stem show excellent biological activity and the potential to be used for pharmaceuticals due to confirmed high antioxidant, antiradical and antitumor activity (Švarc-Gajić et al. 2018).

Fig is also an important fruit in Mediterranean diets and a rich source of sugar, vitamins, and phenolic compounds, such as phenolic acids, flavonols, flavones and proanthocyanidins. Figs are usually consumed fresh or dried and are also used in the wine, juice, puree jelly, jam or other derivate products resulting several by-products such as overripe figs and fig skin which are still rich in bioactive compounds (Viuda-Martos et al. 2015). High-pressure assisted extraction with ethanol can be used for the extraction of total phenolics, flavonoids and tannins from fig by-products in a short time with high extraction yields (Alexandre et al. 2017). Solid-state fermentation (SSF) method can also be used to recover phenolic compounds using fig by-products. This method involves chemical and enzymatic changes from macromolecules to bioactive compounds and provides recovery without using organic solvents. *Aspergillus niger* HT4 can be a good alternative to release the highest amount of total phenolic compounds from fig by-products (Buenrostro-Figueroa et al. 2017).

5.Energy production

Use of food waste in energy production is important for protecting natural resources, sustainability and contributing to the economy. Postharvest wastes are an important source for the production of bioenergy.

Fruit and vegetable wastes are an ideal candidate for fermentation which is necessary for production of biogas and biohydrogen in terms of its moisture content, biodegradability, low total solid and high volatile solid content (Ji et al. 2017).

Postharvest wastes are also thought to have a very high potential for bioethanol production (Deniz et al. 2015). The fact that fruit wastes are rich in fermentable soluble sugar such as glucose, fructose and sucrose together with structural cellulose and hemicellulose, suggests that fruit wastes can be an excellent source of waste biomass for ethanol production (Choi et al. 2015).

The grape pulp is a waste consisting of shell, mash, seed and cap stem obtained at the first step of grape juice and wine production. It is rich in polysaccharides such as cellulose, hemicellulose, pectin and can be converted into fermentable sugars by pre-treatment (Zheng et al. 2012). Guerini et al. (2018) proved that wastes from the sampled wine installation are capable of ensuring energy recovery when they are treated through anaerobic digestion, and analyzing each biomass in parallel, they observed that the grape must show a significantly higher yield when compared to other wastes.

In their study, Giuffrè et al. (2017) showed that the esterification of tomato seed oil could lead to the production of biodiesel complied with the European legislation. However, they pointed out that other variable combinations - time reaction, temperature reaction, alcohol and catalyst amounts-should be investigated for further yield improvement.

Various studies are carried out to develop the cost-effectiveness of bioenergy processes. In a study dark dry fermentation technique was tested, and in experiments to understand the effect of autoclaving as a pretreatment method on fruit and vegetable waste for biohydrogen production, around 30% higher hydrogen production was observed with autoclaved waste compared to non autoclaved waste (Abubackar et al. 2019). It has been shown that the improved organic nitrogen content supply by additional wastes is very important for improved fruit and vegetable waste digestion performance (Bouallagui et al. 2009). Saidi et al. (2018) used the co-digestion process of fruit and vegetable waste with fish waste. It is a cost-effective alternative technology for producing biohydrogen without chemical compounds addition. In a study, the performance of anaerobic digestion of fruit and vegetable waste was compared under psychrophilic, mesophilic and thermophilic conditions in a laboratory scale, and biogas production from the experimental thermophilic digester was higher on average than from psychrophilic and mesophilic (Bouallagui et al. 2004).

Wide variety of fruits are grown in most parts of Turkey (Demirbaş 2008). There is an important biomass energy potential in Turkey (Toklu 2017) and bioenergy should be viewed as the future energy source for development and industry (Bilgen et al. 2014). Within the scope of Turkish-German Biogas project involving the Turkish government, the biogas potential of Turkey was analyzed and the highest theoretical biogas potential was calculated for agricultural residues (Anonymous 2011). It was calculated that approximately 7 thousand tons (8.8 million L) bioethanol could be produced by using pulps which were separated from fruit juice and wine production in 2010 at Turkey (Deniz et al. 2015). Although modern bioenergy technologies are of interest lately in Turkey, there is a general lack of experience in the emerging modern biomass conversion Technologies (Bilgen et al. 2015).

6.Conclusion

Based on the literature, huge amounts of food waste are being generated in Turkey by means of agricultural processing. Nevertheless, in Turkey, limited attention is devoted to waste valorization practices. Different food waste evaluation options such as extraction of bioactive compounds or energy production might be used to achieve sustainable development and a circular economy. By this means, the impact of food wastage could be minimized.

Acknowledgement

The authors would like to thank the many colleagues and institutions in Turkey and in participating countries who have contributed to the work of the ''Best Innovative Approach to Minimize Post Harvest Losses within Food Chain for VET'' Project funded by the ERASMUS+ Program of the European Union.

References

Abubackar, H. N., Keskin, T., Yazgin, O., Gunay, B., Arslan, K. and Azbar, N., 2019. Biohydrogen Production from Autoclaved Fruit and Vegetable Wastes by Dry Fermentation under Thermophilic Condition. International Journal of Hydrogen Energy.

Alexandre, E.M., Araújo, P., Duarte, M.F., de Freitas, V., Pintado, M. and Saraiva, J. A., 2017. High-Pressure Assisted Extraction of Bioactive Compounds from İndustrial Fermented Fig by-Product. Journal of food science and technology, 54(8): 2519-2531.

Anonymous, n.d.. Tomato Production, https://www.ecofog.gf/giec/doc_num.php?explnum_id=998 (Accessed 22.04.2019).

Anonymous, 2011. Resource Efficient and Climate Friendly use of Animal Waste Through Biogas Production in Turkey-Turkish-German biogas project.

Anonymous, 2016. Reducing Post-Harvest Losses in Turkey. http://www.comcec.org/wp-content/uploads/2016/10/8-AGR-PRE-10.pdf (Accessed 18.04.2019).

Anonymous, 2017a. Reducing Food Waste in the OIC Member Countries. http://www.sbb.gov.tr/wpcontent/uploads/2018/11/Reducing_Food_Waste_in_the_OIC_Countries%E2%80%8B.pdf (Accessed 18.04.2019).

Anonymous, 2017b. Bitkisel Üretim İstatistikleri. TUİK, http://www.tuik.gov.tr/ PreTablo.do?alt_id=1001 (Accessed 20.04.2019).

Anonymous, 2018a. Fresh Fruits and Vegetables. https://trade.gov.tr/data/5b8fd55613b8761f041fee87/345bc7ad67aed10d4ace28ccdf5e4616.pdf (Accessed 18.04.2019).

Anonymous, 2018b. Food Losses Volarization Applications Training Material. Post-harvest Project Training Material.

Anonymous, 2019a. Food Loss and Food Waste. http://www.fao.org/food-loss-and-food-waste/en/ (Accessed 18.04.2019).

Anonymous, 2019b. Türkiye Nüfusu. https://www.nufusu.com/(Accessed 27.03.2019).

Azmir, J., Zaidul, I. S.M., Rahman, M.M., Sharif, K.M., Mohamed, A., Sahena, F. and Omar, A.K.M., 2013. Techniques for Extraction of Bioactive Compounds from Plant Materials: A review. Journal of Food Engineering, 117(4): 426-436.

Baiano, A., 2014. Recovery of Biomolecules from Food Wastes-a review. Molecules 19: 14821–14842.

Barcia, M.T., Pertuzatti, P.B., Rodrigues, D., Gómez-Alonso, S., Hermosín-Gutiérrez, I. and Godoy, H.T., 2014. Occurrence of Low Molecular Weight Phenolics in Vitis Vinifera Red Grape Cultivars and their Winemaking by-Products from São Paulo (Brazil). Food research international, 62: 500-513.

Baysal, T., Ersus, S. and Starmans, D., 2000. Supercritical CO2 Extraction of β-carotene and Lycopene from Tomato Paste Waste. Journal of Agricultural Food Chemistry, 48: 5507–5511.

Bilgen, S., Keleş, S., Sarıkaya, İ. and Kaygusuz, K., 2015. A Perspective for Potential and Technology of Bioenergy in Turkey: Present Case and Future View. Renewable and Sustainable Energy Reviews, 48: 228-239.

Black, H. and Michalopoulos, S., 2017. Parliament Calls for Mandatory EU-Wide Food Waste Targets by 2020. https://www.euractiv.com/section/agriculture-food/news/parliament-calls-for-mandatory-eu-wide-food-waste-targets-by-2020/ (Accessed 25.03.2019).

Bouallagui, H., Haouari, O., Touhami, Y., Cheikh, R. B., Marouani, L. and Hamdi, M., 2004. Effect of Temperature on the Performance of an Anaerobic Tubular Reactor Treating Fruit and Vegetable Waste. Process Biochemistry, 39(12): 2143-2148.

Bouallagui, H., Lahdheb, H., Romdan, E. B., Rachdi, B. and Hamdi, M., 2009. Improvement of Fruit and Vegetable Waste Anaerobic Digestion Performance and Stability with co-Substrates Addition. Journal of Environmental Management, 90(5): 1844-1849.

Buenrostro-Figueroa, J.J., Velázquez, M., Flores-Ortega, O., Ascacio-Valdés, J.A., Huerta-Ochoa, S., Aguilar, C.N. and Prado-Barragán, L.A., 2017. Solid State Fermentation of Fig (Ficus carica L.) by-Products Using Fungi to Obtain Phenolic Compounds with Antioxidant Activity and Qualitative Evaluation of Phenolics Obtained. Process Biochemistry, 62: 16-23.

Cádiz-Gurrea, M., Borrás-Linares, I., Lozano-Sánchez, J., Joven, J., Fernández-Arroyo, S. and Segura-Carretero, A., 2017. Cocoa and Grape Seed by Products as a Source of Antioxidant and Anti-inflammatory Proanthocyanidins. International Journal of molecular sciences, 18(2): 376.

Choi, I.S., Lee, Y.G., Khanal, S.K., Park, B.J., Bae, H.J., 2015. A low-energy, cost-effective approach to fruit and citrus peel waste processing for bioethanol Production. Applied Energy, 140: 65-74.

Demirbaş, A., 2008. Importance of Biomass Energy Sources for Turkey. Energy Policy, 36(2): 834-842.

Deniz, E., Yeşilören, G. and İşçi, N.Ö., 2015. Türkiye'de Gıda Endüstrisi Kaynaklı Biyokütle ve Biyoyakıt Potansiyeli. GIDA, 40(1): 47-54.

Dziadek, K., Kopeć, A. and Tabaszewska, M., 2019. Potential of Sweet Cherry (Prunus avium L.) by-Products: Bioactive Compounds and Antioxidant Activity of Leaves and Petioles. European Food Research and Technology, 245(3): 763-772.

Elbadrawy, E., & Sello, A., 2016. Evaluation of nutritional value and antioxidant activity of tomato peel extracts. Arabian Journal of Chemistry, 9, S1010-S1018.

Giuffrè, A.M., Capocasale, M., Zappia, C., Poiana, M., 2017. Biodiesel from Tomato Seed Oil: Transesterification and Characterisation of Chemical-Physical Properties. Agronomy Research, 15(1): 133-143.

Gören, S. and Özdemir, F., 2011. Regulation of Waste and Waste Management in Turkey. Waste Management & Research, 29(4), 433-441.

Guerini, F., M., Lumi, M., Hasan, C., Marder, M., Leite, L.C. and Konrad, O., 2018. Energy Recovery from Wine Sector Wastes: a Study About the Biogas Generation Potential in a Vineyard from Rio Grande do Sul, Brazil. Sustainable Energy Technologies and Assessments, 29: 44-49.

İnal, O., 2010. İnorganik ve Organik Maddeler Karıştırılmış Cibrenin, Fide Üretiminde ve Topraksız Tarımda, Yetiştirme Ortamı Olarak Kullanım Olanakları (Master's thesis, Namık Kemal Üniversitesi).

Ji, C., Kong, C. X., Mei, Z.L. and Li, J., 2017. A Review of the Anaerobic Digestion of Fruit and Vegetable Waste. Applied Biochemistry and Biotechnology, 183(3): 906-922.

Lovrenčić, Đ., Vretenar, N. and Ježić, Z., 2017. The Challenges of Establishing Food Donation System. In International Scientific Conference on IT, Tourism, Economics, Management and Agriculture–ITEMA.

Meireles, M.A.A., 2008. Extracting bioactive compounds for food products: theory and applications. CRC press.

Mikar, A.M., 2011. Soğuk Cam Serada, İnorganik, Organik Maddeler ve Besin Elementleri Karıştırılmış Öğütülmüş Cibrelerde Yetiştirilen Kıvırcık Baş Salatada, Gelişme ve Verimin, Diğer Ortamlarla Karşılaştırılması (Master's thesis, Namık Kemal Üniversitesi).

Nobre, B.P., Gouveia, L., Matos, P.G., Cristino, A.F., Palavra, A.F. and Mendes, R.L., 2012. Supercritical Extraction of Lycopene from Tomato İndustrial Wastes with Ethane. Molecules, 17(7): 8397-8407.

Nour, V., Panaite, T.D., Ropota, M., Turcu, R., Trandafir, I. and Corbu, A.R., 2018. Nutritional and Bioactive Compounds in Dried Tomato Processing Waste. CyTA: Journal of Food, 16(1): 222-229.

Papargyropoulou, E., Lozano, R., Steinberger, J.K., Wright, N. and bin Ujang, Z., 2014. The Food Waste Hierarchy as a Framework for the Management of Food Surplus and Food Waste. Journal of Cleaner Production, 76: 106-115.

Pintać, D., Majkić, T., Torović, L., Orčić, D., Beara, I., Simin, N. and Lesjak, M., 2018. Solvent Selection for Efficient Extraction of Bioactive Compounds from Grape Pomace. Industrial Crops and Products, 111: 379-390.

Popa, V., Misca, C., Bordean, D., Raba, D. N., Stef, D. and Dumbrava, D., 2011. Characterization of Sour Cherries (Prunus cerasus) Kernel Oil Cultivars from Banat. J Agroaliment Process Technol, 17(4): 398-401.

Salihoğlu, G., Salihoglu, N. K., Ucaroglu, S. and Banar, M., 2018. Food Loss and Waste Management in Turkey. Bioresource Technology, 248: 88-99.

Sagar, N.A., Pareek, S., Sharma, S., Yahia, E.M. and Lobo, M.G., 2018. Fruit and Vegetable Waste: Bioactive Compounds, their Extraction, and Possible Utilization. Comprehensive Reviews in Food Science and Food Safety, 17(3): 512-531.

Saidi, R., Liebgott, P. P., Hamdi, M., Auria, R. and Bouallagui, H., 2018. Enhancement of Fermentative Hydrogen Production by Thermotoga Maritima Through Hyperthermophilic Anaerobic co-digestion of Fruit-Vegetable and Fish Wastes. International Journal of Hydrogen Energy, 43(52): 23168-23177.

Savatović, S.M., Ćetković, G.S., Čanadanović-Brunet, J. M. and Đilas, S.M., 2010. Utilization of tomato Waste as a Source of Polyphenolic Antioxidants. Acta Periodica Technologica, 41: 187–194.

Shahidi, F. and Yeo, J., 2018. Bioactivities of Phenolics by Focusing on Suppression of Chronic Diseases: A review. International journal of molecular sciences, 19(6): 1573.

Simonetti, G., D'Auria, F. D., Mulinacci, N., Milella, R. A., Antonacci, D., Innocenti, M. and Pasqua, G., 2017. Phenolic Content and in Vitro Antifungal Activity of Unripe Grape Extracts from Agro-industrial Wastes. Natural Product Research, 1-5.

Švarc-Gajić, J., Cerdà, V., Clavijo, S., Suárez, R.,

Mašković, P., Cvetanović, A. and Novakov, V., 2018. Bioactive Compounds of Sweet and Sour Cherry Stems Obtained by Subcritical Water Extraction. Journal of Chemical Technology & Biotechnology, 93(6): 1627-1635.

Takizawa, A., Hyodo, H., Wada, K., Ishii, T., Satoh, S. and Iwai, H. 2014. Regulatory Specialization of Xyloglucan (XG) and Glucuronoarabinoxylan (GAX) in Pericarp Cell Walls during Fruit Ripening in Tomato (Solanum lycopersicum). PloS one, 9(2).

Tang, G.Y., Zhao, C.N., Liu, Q., Feng, X.L., Xu, X.Y., Cao, S.Y. and Li, H.B., 2018. Potential of Grape Wastes as a Natural Source of Bioactive Compounds. Molecules, 23(10): 2598.

Tatlıdil, F.F., Dellal, İ. and Bayramoğlu, Z., 2013. Food Losses and Waste İn Turkey-Country Report. http://www.fao.org/3/a-au824e.pdf (Accessed 15.04.2019

Toklu, E., 2017. Biomass Energy Potential and Utilization in Turkey. Renewable Energy, 107: 235-244.

Virot, M., Tomao, V., Le Bourvellec, C., Renard, C. and Chemat, F., 2010. Towards the İndustrial Production of Antioxidants from Food Processing by-Products with Ultrasound-Assisted Extraction. Ultrason. Sonochem., 17: 1066–1074.

Viuda-Martos, M., Barber, X., Perez-Alvarez, J.and Fernandez-Lopez, J., 2015. Assessment of Chemical, Physico-Chemical, Techno-Functional and Antioxidant Properties of Fig (Ficuscarica L.) Powder co-products. Industrial Crops and Products, 69: 472-479.

Yurdagel, Ü., Yaman, Ü.R. ve Baysal, T., 1997. Meyve-Sebze İşleme Sanayiinde Su, Atık Su Arıtılması, Artık ve Atıkların Değerlendirilmesi. Tire Meslek Yüksek Okulu, Yayın No:1, E.Ü. Basımevi, İzmir.

Zheng, Y., Lee, C., Yu, C., Cheng, Y.S., Simmons, C.W., Zhang, R. and VanderGheynst, J.S., 2012. Ensilage and Bioconversion of Grape Pomace into Fuel Ethanol. Journal of Agricultural and Food Chemistry, 60 (44): 11128-11134.