

AKÜ FEMÜBİD 21 (2021) 015402 (122-129)

AKU J. Sci. Eng. 21 (2021) 015402 (122-129)

DOI: 10.35414/akufemubid.579032

Araştırma Makalesi / Research Article

Utilization of Some Plant Based Wastes for a Possible Formulation of Tea Infusion

Derya ARSLAN DANACIOĞLU*, Merve PEKEL

Department of Food Engineering, Faculty of Engineering and Architecture, Necmettin Erbakan University, Koycegiz Campus, Konya.

Corresponding author *e-mail: dears@konya.edu.tr ORCID ID: <https://orcid.org/0000-0002-6655-9312>
e-mail: mrvpekel@outlook.com ORCID ID: <https://orcid.org/0000-0002-3085-8863>

Geliş Tarihi: 17.06.2019

Kabul Tarihi: 11.02.2021

Abstract

Keywords

Fruit peels; Walnut shells; DPPH; Phenolics; Sensory analysis; Functional foods.

The main objective of the current study was to investigate the potential of plant based wastes to be used as tea infusions having beneficial health effects. With this purpose, three different formulations of tomato peel, lemon peel, onion peel, tangerine peel, walnut and hazelnut shell, oleaster, olive leaves, cypress cone and hawthorn were developed and these tea blends were evaluated in terms of total phenolics, radical scavenging activity, color and sensory properties. Final beverages contained considerable phenolic contents and showed significant antioxidant activity. The infusion of onion peel, lemon peel, walnut shell and cypress cone blend contained the highest amount of total phenolics (160.2 mg GAE/L). However, tomato peel, hawthorn, olive leaf and cypress cone blend showed good DPPH radical scavenging activity (79.65%) and appreciated with higher scores by sensory analysis.

Bazı Bitki Kaynaklı Atıkların Çay İnfüzyonu Olarak Değerlendirilmesi

Öz

Anahtar kelimeler

Meyve kabukları; Ceviz kabuğu; DPPH; Fenolikler; Duyusal analiz; Fonksiyonel gıdalar.

Bu çalışmanın amacı, bitkisel kaynaklı bazı atıkların sağlık üzerinde olumlu etkileri olan çay infüzyonları olarak kullanım potansiyellerini ortaya koymaktır. Bu amaçla, domates kabuğu, limon kabuğu, soğan kabuğu, mandalina kabuğu, ceviz kabuğu, fındık kabuğu, iğde, zeytin yaprağı, selvi kozalağı ve alıçtan oluşan üç farklı formülasyon geliştirilmiştir. Bu çay karışımları toplam fenolik madde ve radikal tutucu aktivite, renk ve duyuşal özellikler açısından değerlendirilmiştir. Elde edilen içeceklerin önemli seviyede fenolik madde içeriğine ve antioksidan aktiviteye sahip olduğu tespit edilmiştir. Soğan, limon ve ceviz kabuğu karışımından elde edilen infüzyon en yüksek miktarda toplam fenolik (160.2 mg GAE/L) bileşen içeren infüzyon olmuştur. Bununla birlikte, domates kabuğu, alıç, selvi kozalağı ve zeytin yaprağı karışımı DPPH radikal yakalama aktivitesi (%79.65) açısından daha üstün bulunmuş ve ayrıca duyuşal analizlerde de daha yüksek skorlarla değerlendirilmiştir.

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1. Introduction

Nowadays, the largest volume of waste produced worldwide in food industry, which the most losses are caused by fruits and vegetables. In developing countries, fruit and vegetable losses are severe at the agricultural stage but particularly occur during the processing step, which accounts for 25% of losses (Farzaneh and Carvalho 2015, Joshi and Devraj 2008). The waste parts such as peels, seeds and stones generated from the fruit-vegetable and nut processing can be successfully used as a source

of food ingredients, phytochemicals, antimicrobials and antioxidatives. The use of these by-products as a valuable source of natural food additives appears to be a good resource for reducing environmental problems and for food additives or supplements that are high in nutritional value and economically alluring. By converting these by-products into a high-value product; companies can reduce their costs and even make additional profits. Herbal teas have beneficial health effects due to their high phenolic content. Therefore, these drinks are one of the most important sources of polyphenols that

promote health in our diet (Büyükbacı and El 2008; Parr and Bolwell 2000). The common consumption of herbal teas can be attributed mainly to their therapeutic and energizing effects (Ravikumar 2014).

The food and agricultural processing industry creates substantial quantities of by-products with high content of phenolics that could be that could be valuable natural sources of antioxidants. Some of these by-products, such as buckwheat hull (Zielinska 2009 2013) banana peel (Pure and Pure 2016), dragon fruit peel (Sari and Hardiyanti 2013), rooibos waste (Sishi 2018), olive leaves (Gamli *et al.* 2018), onion peel (Matsunaga *et al.* 2013) have been the subject of investigations related to infusions or decoctions.

Tomato, olive and nuts processing generates a considerable amount of waste plant material in the form of peel, leaves and shell. The bioactive properties of these by-products were demonstrated in previous studies (Chen *et al.* 2017, Delgado *et al.* 2010, Omar 2010, Valdez-Morales *et al.* 2014, Jung *et al.* 2011). Therefore, the purpose of this study was to formulate new mixtures of tea infusions and determine the sensory profiles of these tea samples obtained from waste plant material, to evaluate the feasibility of possibly reutilizing food industry. Three different formulations consisting of tomato peel, lemon peel, onion peel, tangerine peel, walnut and hazelnut shell, oleaster, olive leaves, cypress cone and hawthorn were developed and these tea mixtures were evaluated in terms of total phenolics, radical scavenging activity, color and sensory properties. We propose production of new blends with acceptable quality for the herbal tea market.

2. Material and Method

2.1 Chemicals

1,1-diphenyl-2-picrylhydrazyl (DPPH), gallic acid, Folin-ciocalteu's reagent, Sodium carbonate were purchased from Sigma-Aldrich (St. Louis, MO, USA). Methanol (HPLC grade) were provided by Merck (Darmstadt, Germany). Water was purified with a Milli-Q-system (Milipore, Bedford, MA, USA).

2.2 Plant materials and preparation of tea infusions

Two hundred grams of each material were used. Tomatoes (*Solanum lycopersicum*), lemon (*Citrus limonum*), onion peel (*Allium cepa*), tangerine (*Citrus tangerina*), walnut (*Juglans regia*), hazelnut (*Corylus avellana*) were purchased from a local market in Konya, Turkey. Olive leaves (*Olea europea* L.), cypress cone (*Cupressus goveniana*) and hawthorn (*Crataegus tanacetifolia*) and oleaster (*Elaeagnus angustifolia* L.) were acquired from a spice selling market which were collected in different locations of Turkey, namely Mersin and Konya in October 2016. The fruits and vegetables were washed with tap water. The peel, pulp and shell parts of the fruits, vegetables and nuts were manually separated. Tomato, orange and tangerine peels, hawthorn and oleaster pulps were chopped, afterwards were dried in a laboratory oven at 40°C for 24 hours. Walnut and hazelnut shell, dried peels and pulps were powdered by a grinder into coarse particles (sievable through 2 mm mesh size) in order to avoid turbidity in tea samples. Cypress cone was used (0.4%) to give aroma to mixed tea formulations.

As a result of the preliminary trials, the study continued on 3 formulations that received the most appreciation.

Three different mixtures (2.5 g in tea bags) of tea samples were formulated as given below:

- [1] Tomato peel (0.5 g), hawthorn (0.5 g), olive leaves (0.75 g), cypress cone (0.75 g) (will be referred as tomato peel tea in the text)
- [2] Tangerine peel (0.5 g), hazelnut shell (0.75 g), oleaster (0.5 g), cypress cone (0.75 g) (will be referred as hazelnut shell tea in the text)
- [3] Onion peel (0.25 g), lemon peel (0.5 g), walnut shell (0.75 g), cypress cone (0.75 g) (will be referred as walnut shell tea in the text)

Infusions were prepared by leaving 2.5 g of dried samples with 200 mL of 90°C water for four minutes (Han *et al.* 2019). Two replicates for each sample were performed. Analyzes were carried out in duplicate. Teas prepared in triplicate were directly subjected to analysis.

2.3 Color analysis

Objective color measurements of all infusions (L^* , a^* , b^*) were conducted in transmission mode with a CR-400 Konica Minolta Colorimeter (Konica Minolta Sensing Inc., Tokyo, Japan), using proper sample containers for liquids. The C^* and h^* values were calculated from the L^* , a^* and b^* values. Ten measurements were performed on each sample. L^* measures the degree of whiteness of a color as the color brightness coordinate, and 100 points to black, and 0 points to white. a^* measures red when positive and green when negative and b^* corresponds to yellow when positive and blue when negative.

2.4 Determination of total phenolics (TPC)

2.5 g of each sample was soaked in 50 mL water in order to get absorbance values between the values of standard limits. The teas were filtrated through a cellulose paper filter (Whatman no. 40). The total phenol contents of the tea samples were determined using the Folin-Ciocalteu method (Singleton *et al.* 1999), reading samples on a Shimadzu UV-vis mini spectrophotometer 1240 at 765 nm. Results were expressed as gallic acid equivalents (mg GAE/L). Gallic acid calibration standards were prepared in duplicate at ten concentrations within the range of 0-500 mg/L.

2.5 DPPH Radical scavenging activity (DPPH-RSA)

The radical scavenging effect of tea samples towards the 2,2-diphenyl-1-picrylhydrazyl (DPPH \bullet) were measured as reported previously by Singh, Murthy, and Jayaprakasha, (2002). Five milliliters of a 0.1 mm methanol solution of DPPH were added to 0.1 ml of infusion. The tubes were kept at 27°C for 20 min. The absorbance (A) at 517 nm was determined in a spectrophotometer (Shimadzu UV-vis mini spectrophotometer 1240). The radical scavenging activity, expressed as a percentage of inhibition, was calculated by the formula:

Percent radical scavenging activity

$$= \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100 \quad (1)$$

2.6 Sensory analysis

The sensory evaluation was performed at Necmettin Erbakan University, in the laboratories of Department of Food Engineering, with a staff of 30 non-trained volunteer panelists. The participants in the sensory analysis received the tea samples in glass cups and they were asked to rate the samples in terms of color, taste, odor, appearance and overall acceptance. The judges used the hedonic scale, anchored at the ends with 'like extremely' (7) to 'dislike extremely' (1) as the acceptance test (Rotta *et al.* 2016). The analysis were carried out with two replications.

2.7 Statistical analysis

The statistical differences between the results of infusion, total phenolic content and radical scavenging activity were analyzed by Duncan test using an analysis of variance (ANOVA) procedure with SPSS software version 18.0 at a significance level of 0.05.

3. Results and Discussion

The results of TPC are summarized in Table 1. The walnut shell tea had the highest TPC with values between 102.8-176.5 mg GAE/L. The tea samples can be ordered as walnut shell blend>tomato peel blend leaf>hazelnut shell blend, in terms of their total phenolic contents. Walnut shell tea contained 22.5% and 44.2% more phenolic component than those of tomato peel and hazelnut shell tea, respectively. Catechin, epicatechin gallate, and gallic acid are the most abundant phenolics in hazelnut shell (Yuan *et al.* 2018). Ethanol-water extracts of walnut shells contain 197.6 mg/kg flavonoids in 317 mg GAE/ g of total phenolics (Queirós *et al.* 2019). Outer dry layers of onion bulb contains high concentrations of quercetin (Jung *et al.* 2011) and onion peel has strong antioxidant

activity which quercetin was proposed as responsible for this activity. The predominant phenolics in onion skin extracts were reported as quercetin 3,4-diglucoside, quercetin, and kaempferol by Albishia *et al.* (2013).

Table 1. Total phenolics content and radical scavenging activity of some tea infusions

Tea infusions	Total phenolics (mg GAE/L)	DPPH-RSA [†] (%)
Tomato peel tea	144.46±0.59 ^{b*}	79.65±2.13 ^a
Hazelnut shell tea	115.73±1.62 ^c	76.17±1.95 ^b
Walnut shell tea	160.21±1.97 ^a	73.98±2.17 ^c

*Values are the mean of 6 replications and standard deviations were given next to the values.

[†]DPPH-RSA: DPPH radical scavenging activity

The DPPH radical scavenging activity of the tea samples were above 70% percent for all of the tea samples even the differences between the samples were significant as confirmed by statistical method (Table 1). The order of samples was not the same as total phenolics; that is tomato peel tea possessed the highest level of DPPH radical scavenging activity. In contrast to total phenolics data, the lowest DPPH radical scavenging activity was measured on walnut shell tea. This phenomenon can be explained by the presence of non-phenolic compounds in tomato peel-olive leaf tea which have high radical scavenging activity. For instance, Valdez-Morales *et al.* (2014) determined the phenolics compounds in tomato peel as as caffeic acid, ferulic acid, chlorogenic acids, quercetin-3- β -O-glycoside, and quercetin. The authors observed positive antimutagenic results and proposed that tomato by-products including the peels could be used as a source of potential nutraceutical compounds.

Although not in terms of total phenolic results, the results of Amariei *et al.* (2016) support our results in terms of radical scavenging capacity. In their study, walnut shell infusion showed a reduced radical scavenging capacity (7.82%), in direct proportion to its low total phenolic content (32.08 mg GAE/g). However, they stated that onion peel infusion showed high total phenolics content (280.32 mg GAE/g) and again high DPPH radical scavenging activity (69.38%).

Tomato peel is known to contain several flavonoids with bioactive effects on health such as rutin, naringenin and quercetin. The main phenolic acids identified in tomato peel are caffeic, protocatechuic, vanillic, catechin and gallic acid (González *et al.* 2011).

Due to the essential amino acids and fatty acids it contains, as well as flavonoids, phenolic acids, lycopene, ascorbic acid and minerals, tomato peel has high nutritional value and has a strong antioxidant effect. It has been suggested that it can be considered as a source to increase antioxidant intake in the human diet and to enrich foods in this respect (Elbadrawy and Sello, 2016).

The major uses of olive leaves are in animal feed (Paiva-Martins and Pinto 2008) and Mediterranean folk medicine (Omar 2010) because of containing a great quantity of polyphenols and flavonoids. The most abundant polyphenolic compounds in olive leaves are secoiridoids being the predominant compounds e.g., oleuropein, ligstroside, dimethyleuropein and hydroxytyrosol (Cifá *et al.* 2018).

It is reported that extraction of olive leaf which contains higher amount of oleuropein prevents the oxidation of lipoprotein that plays important role as a food additive (Visioli *et al.* 1995; Tuck and Hayball 2002).

Hazelnut tea took place between the walnut shell and tomato peel tea samples in terms of both the total phenolics content and radical scavenging activity. Delgado *et al.* (2010) reported that hazelnut and walnut kernels contain higher concentrations of total phenolics than those of almonds, pine nuts and peanuts. They concluded that some nuts could be included in new health-related products as natural bioactive component sources, or they could replace suspected synthetic compounds that promote human health and reduce disease risks. Similarly, in a study carried out on buckwheat hull tea, radical scavenging activity and flavonoid content did not show a correlation (Zielinska *et al.* 2013). The antioxidant capacity of buckwheat hull tea measured against DPPH radicals was almost twice as higher than that obtained after 80% methanol

extraction. The authors' explanation for this finding was the presence of other antioxidants with high radical scavenging activity in buckwheat stem tea. Because buckwheat hull tea and 80% methanol extract contained almost the same level of flavonoids. However, many studies confirmed a linear relationship between total phenolic contents and antioxidant activities (Oliveira *et al.* 2012). Li *et al.*, (2009) reported that increasing total phenolic content of material such as *radix angelicae sinensis* extracts resulted in higher DPPH values.

Phenolic acids, flavonoids and tannins as phenolics are among the most common component groups found in the plant kingdom (Pandey and Rizvi 2009), and they are effective against diseases caused by oxidative stress (e.g. cancer, diabetes, coronary and neurodegenerative illnesses) due to their potent redox properties, as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators (Parr and Bolwell 2000).

No significant differences in L* values were observed for all tea samples (P>0.05) (Table 2). a* values of tomato peel and hazelnut shell teas were found inside the green area. The values of onion-walnut shell tea belonged to red area which was more appreciated by the panelists taking into

account the slightly higher color scores. Regarding the b* values, onion tea showed values closer to yellow area.

Table 2. Color indices of the tea infusions

Tea infusions	L*	a*	b*
Tomato peel tea	27.9±0.52 a ¹	-0.43±0.06 c	0.73±0.03 b
Hazelnut shell tea	27.46±0.02 a	-0.34±0.12 b	0.43±0.10 b
Walnut shell tea	27.09±0.33 a	1.26±0.08 a	1.36±0.10 a

¹Values are the mean of 3 replications and standard deviations were given next to the values.

Figure 1 presents the sensory analysis results of infusions from tea bags of the three different formulations. The taste scores for tomato pee tea were all equal or above 6. This score was above 5 (average 5.46) for hazelnut tea which means both tea samples were found more acceptable than walnut tea by the panelists. The samples had color, appearance, taste and odor scores not being lower than 4, indicating that the products were not rejected by the panelists. The samples did not differ from each other in terms of color scores according to statistical analysis results. Tomato peel tea sample was the most liked, with an average taste score of 6.5, while the least liked sample was the one with the walnut shell (taste score average 4.6).

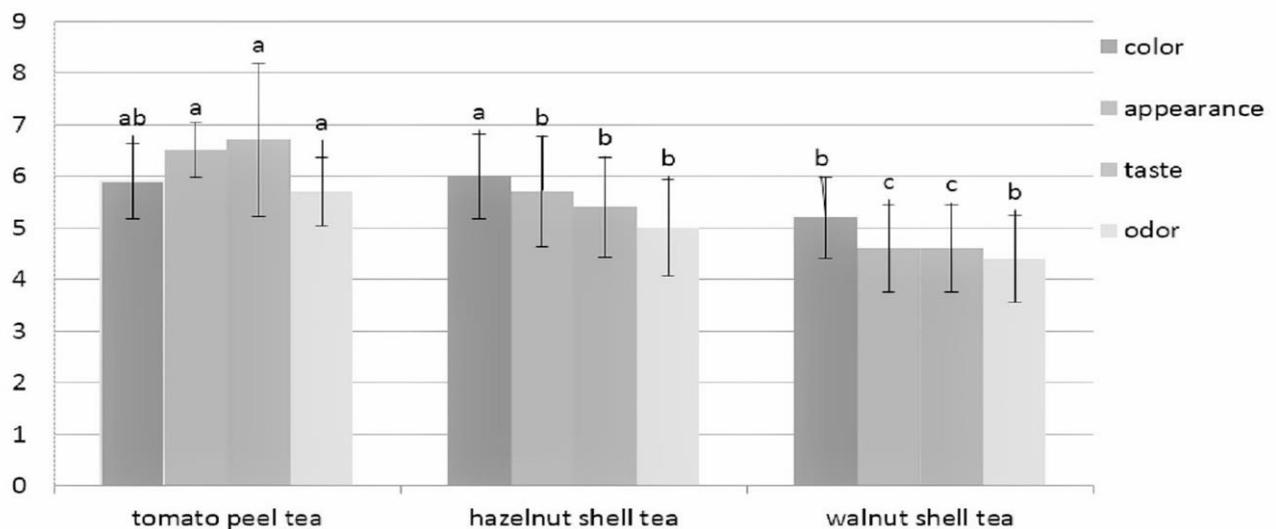


Figure 1. Sensory analysis results of three different tea infusions

4. Conclusions

According to the acceptance test, none of the tea blends were rejected by the panelists, and they also indicated that they intend to buy this new product if it was to be marketed. Sensory analysis on the samples showed higher taste, odor and appearance scores for tea samples comprising of olive leaf, tomato peel and hawthorn. The significantly highest content of total phenolics was recorded in the tea bags of onion peel, lemon peel and walnut shell. However it should be noted that this sample showed the lowest DPPH radical scavenging activity. In this sense, we can say that the antioxidant activity of onion peel-walnut shell-lemon peel tea blend does not reflect its high content in phenolics in terms of radical scavenging activity. Although lower than those obtained with olive leaf-tomato peel-hawthorn blend, the infusions from other two blends (tangerine peel-hazelnut shell-oleaster; and onion peel-lemon peel-walnut shell) were still rich in phenolics. Further studies could be performed, formulating tea blends with different sources of plant wastes or different reverse versions of the blends, changing variables like brewing time and water temperature could also be focused to achieve a higher antioxidant and likable beverage. This study can be considered as a preliminary study in terms of showing that some food waste such as tomato peel, tangerine peel, and hazelnut shell can be used in tea formulations. However, these materials must be evaluated in a toxicological manner prior to the application.

5. Kaynaklar

Albishia, T., Johna, J.A., Al-Khalifab, A.S. and Shahidi, F., 2013. Antioxidative phenolic constituents of skins of onion varieties and their activities. *Journal of Functional Foods*, **5**, 1191 – 1203.

Amariei, S. and Mancas, V., 2016. Total phenolic content and antioxidant activity of infusions from two by-products: walnut (*Juglans regia* L.) shell and onion (*Allium cepa* L.), *Food and Environment Safety - Journal of Faculty of Food Engineering*, **15**(2), 280-186.

Büyükbacı, A. and El, S.N., 2008. Determination of *in vitro* antidiabetic effects, antioxidant activities and phenol contents of some herbal teas. *Plant Foods for Human Nutrition*, **63**, 27–33.

Chen, X-M., Tait, A.R. and Kitts, D.D., 2017. Flavonoid composition of orange peel and its association with antioxidant and anti-inflammatory activities, *Food Chemistry*, **218**, 15-21.

Cifá, D., Skrt, M., Pittia, P., Di Mattia, C.D. and Poklar Ulrih, N., 2018. Enhanced yield of oleuropein from olive leaves using ultrasound-assisted extraction. *Food Science and Nutrition*, **6**, 1128–1137.

Delgado, T., Malheiro, R., Pereira, J.A. and Ramalhosa, E., 2010. Hazelnut (*Corylus avellana* L.) kernels as a source of antioxidants and their potential in relation to other nuts. *Industrial Crops and Products*, **32**, 621–626.

Elbadrawy, E., Sello, A., 2016. Evaluation of nutritional value and antioxidant activity of tomato peel extracts. *Arabian Journal of Chemistry*, **9**, 1010-1018.

Farzaneh, V. and Carvalho, I.S., 2015. A review of the health benefit potentials of herbal plant infusions and their mechanism of actions. *Industrial Crops and Products*, **65**, 247–258.

Gamlı, Ö.F., Süfer, Ö., Eker, T., 2018. Dehydration kinetics and infusion attributes of microwave dried olive leaves. *Turkish Journal of Agricultural Food Science and Technology (TURJAF)*, **6**(8), 963-970.

González, I.N., Valverde, V.G., Alonso, J.G. and Periago M.G., 2011. Chemical profile, functional and antioxidant properties of tomato peel fiber. *Food Research International*, **44**, 1528-1535.

Han, A.-R., Nam, B., Kim, B.-R., Lee, K.-C., Song, B.-S., Kim, S.H., Kim, J.-B. and Jin, C.H., 2019. Phytochemical composition and antioxidant activities of two different color *Chrysanthemum* flower teas. *Molecules*, **24**, 329.

Joshi, V.K., Devrajan, A., 2008. Ethanol recovery from solid state fermented apple pomace and evaluation of physico-chemical characteristics of residue. *Natural Product Radiance*, **7**, 127-132.

- Jung, J.Y., Lim, Y., Moon, M.S., Kim, J.Y., Kwon, O., 2011. Onion peel extracts ameliorate hyperglycemia and insulin resistance in high fat diet/streptozotocin-induced diabetic rats, *Nutrition and Metabolism*, **8**, 18.
- Li, X., Wu, X., Huang, L., 2009. Correlation between antioxidant activities and phenolic contents of radix *Angelicae sinensis* (Danggui). *Molecules*, **14**(12), 5349-5361.
- Matsunaga, S., Azuma, K., Watanabe, M., Tsuka, T., Imagawa, T., Osaki, T. and Okamoto, Y., 2013. Onion peel tea ameliorates obesity and affects blood parameters in a mouse model of high-fat-diet-induced obesity. *Experimental and Therapeutic Medicine*, **7**, 379-382.
- Oliveira, R.M.M., 2012. Quantificação de catequinas e cafeína do chá verde (*Camellia sinensis*) infusão, extrato e bebida pronta. *Ciência e Tecnologia de Alimentos*, **32**(1), 163-166.
- Omar, S.H., 2010. Oleuropein in olive and its pharmacological effects. *Scientia Pharmaceutica*, **78**(2), 133-154.
- Paiva-Martins, F., Pinto, M., 2008. Isolation and characterization of a new hydroxytyrosol derivative from olive (*Olea europaea*) leaves. *Journal of Agricultural and Food Chemistry*, **56**(14), 5582-5588.
- Pandey, K.B., Rizvi, S.I., 2009. Plant polyphenols as dietary antioxidants in human health and disease. *Oxidative Medicine and Cell Longevity*, **2**, 270-278.
- Parr, A.J., Bolwell, G.P., 2000. Phenols in the plant and in man. The potential for possible nutritional enhancement of the diet by modifying the phenols content or profile. *Journal of the Science of Food and Agriculture*, **80**, 985-1012.
- Pure, A.E. and Pure, M.E., 2016. Antioxidant and antibacterial activity of kombucha beverages prepared using banana peel, common nettles and black tea infusions. *Applications of Food Biotechnology*, **3**(2), 125-130.
- Queirós, C.S.G.P., Cardoso, S., Lourenço, A., Ferreira, J., Miranda, I., Lourenço, M.J.V., Pereira, H., 2019. Characterization of walnut, almond, and pine nut shells regarding chemical composition and extract composition. *Biomass Conversion and Biorefinery*, **2**, 1-14.
- Ravikumar, C., 2014 Review on herbal teas. *Journal of Pharmaceutical Sciences & Research*, **6**(5), 236-238.
- Rotta, E.M., Morais, D.R., Biondo, P.B.F., Santos, V.J., Matsushita, M. and Visentainer, J.V., 2016. Use of avocado peel (*Persea americana*) in tea formulation: a functional product containing phenolic compounds with antioxidant activity. *Acta Sci-Technol*, Maringá, **38**(1), 23-29.
- Sari, A.R. and Hardiyanti, R., 2013. Antioxidant level and sensory of dragon fruit (*Hylocereus undatus*) peel tea infusion made by partially fermented process. *Agroindustrial J*, **2**-1, 63-68.
- Singh, R.P., Chidambara Murthy, K.N. and Jayaprakasha, G.K., 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.
- Singleton, V.L., Orthofer, R. and Lamuela-Raventos, R.M., 1999. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteu reagent. *Methods in Enzymology*, 299, San Diego, CA. Academic Press. 152-178.
- Sishi, M., 2018. Evaluation of Rooibos waste plant material for the development of a high-value herbal tea product (Master thesis), Stellenbosch University, Stellenbosch, South Africa, p210.
- Tuck, K.L. and Hayball, P.J., 2002. Major phenolic compounds in olive oil: metabolism and health effects. *Journal of Nutritional Biochemistry*, **13**(11), 636-644.
- Valdez-Morales, M., Espinosa-Alonso, L.G., Espinoza-Torres, L.C., Delgado-Vargas, F. and Medina-Godoy, S., 2014. Phenolic content and antioxidant and antimutagenic activities in tomato peel, seeds, and by products. *Journal of Agricultural and Food Chemistry*, **62**, 5281-5289.
- Visioli, F., Bellomo, G., Montedoro, G. and Galli, C., 1995. Low density lipoprotein oxidation is inhibited *in vitro* by olive oil constituents. *Atherosclerosis*, **117**(1), 25-32.

Yuan, B., Lu, M., Eskridge, K.M., Isom, L.D., Hanna, M.A., 2017. Extraction, identification, and quantification of antioxidant phenolics from hazelnut (*Corylus avellana* L.) shells. *Food Chemistry*, **244**, 7-15.

Zielinska, D., Szawara-Nowak, D. and Zieliński, H., 2009. Antioxidative and anti-glycation activity of bitter buckwheat tea. *European Journal of Plant Science Biotechnology*, **3** (S11), 79–83.

Zielinska, D., Szawara-Nowak, D. and Zielinski, H., 2013. Antioxidative and anti-glycation activity of buckwheat hull tea infusion, *International Journal of Food Properties*, **16**, 228–239.