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COMPARISON OF CHEMICAL AND ANTIOXIDANT PROPERTIES OF MENTHA PIPERITA L., SALVIA OFFICINALIS L., ROSMARINUS OFFICINALIS L. AND LAVANDULA ANGUSTIFOLIA L.

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Abstract: 4 different plant species belonging to the same family mint (*Mentha piperita*), sage (*Salvia officinalis*), rosemary (*Rosmarinus officinalis*), lavender (*Lavandula angustifolia*) were harvested from the Afyon region. Total antioxidant and phenolic contents were analyzed by DPPH and Folin-Ciocalteu method. The effect of extra virgin olive oils oxidation stability was tested by means of rancimat method. According to DPPH analysis results, *M. piperita* is the highest antioxidant capacity and the radical scavenging activity is 95.31%. The radical scavenging activities of *S. officinalis*, *R. officinalis* and *L. angustifolia* are respectively 91.83%, 54.28%, and 18.85%. The total phenolic content of *M. piperita*, *S. officinalis*, *R. officinalis* and *L. angustifolia* plants as gallic acid were respectively; 0.32, 0.28; 0.26 and 0.18 mg/100ml. According to the results of the study, the order of the plants did not change in terms of phenolic and antioxidant content, *M. piperita* has the highest values and *L. angustifolia* has the lowest. It was also found that the plants are effective on the oxidation stability of extra virgin olive oil and prevent oxidation in the order of large to small *R. officinalis*, *M. piperita*, *S. officinalis* and *L. angustifolia*.

Keywords: *Mentha piperita* L, *Salvia officinalis* L, *Rosmarinus officinalis* L., *Lavandula angustifolia* L, Phenolic content, Antioxidant

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1. Introduction

Mentha piperita is one of the most important, most common and aromatic herbs. It belongs to the Lamiaceae family (Tsai et al., 2013). The *M. piperita* has antibacterial, antifungal and antioxidant properties,and its essential oil include menthol (36.02%), menthone (24.56%), menthyl acetate (8.95%), and menthofuran (6.88%) (Singh et al., 2015; Ilboudo et al., 2016; Desam et al., 2019) Some essential components and phenolic compounds of *M. piperita* leaves are caffeic acid, rosmarinic acid, cinnamic acid, eryositrin, luteolin-7-O-glucoside, and represent about 20% weight of dry matter (Dorman et al., 2009; Farnad et al., 2014). *S. officinalis* is a plant in the Lamiaceae family. Grows in the Middle East and Mediterranean regions. In folk medicine, *S. officinalis* has been used for the treatment of various disorders such as seizures, ulcers, gout, rheumatism, inflammation, dizziness, tremor, stroke, diarrhea and hyperglycemia. The essential components of essential oil are borneol, camphor, caryophyllene, cineol, sieve, humulene, leden, pinene and thujone. The alcoholic and aqueous extracts of *S. officinalis* are rich flavonoids, especially rosmarinic acid and luteolin-7-glucoside. In addition, phenolic acids such as caffeic acid and 3-Caffeoylquinic acid were found in the methanolic extract of *S. officinalis*. Various flavonoids such as chlorogenic acid, ellagic acid, epicatechin, epigallocatechin gallate, quercetin, rosmarinic acid, routine and luteolin-7-glucoside, as well as volatile components such as borneol, cineole, camphor and thujone have been described (Ghorbani and Esmaeilizadeh, 2017). *Rosmarinus officinalis* is a widely consumed aromatic plant of the Lamiaceae family. Fresh and dried leaves are often used in traditional Mediterranean cuisine and folk medicine. *R. officinalis* is known to have antioxidant, antibacterial and antifungal, anti-cancer, anti-inflammatory effects. Therefore, it has a wide range of industrial applications such as food and food packaging, pharmaceutical, perfumery and cosmetic industries (Ribeiro-Santos et al., 2015). *Lavandula angustifolia* is a perennial plant of the Lamiaceae family. Its origin is Southern European and Mediterranean and commercially grown in many countries. It has antifungal antibacterial and antioxidant properties (Blažeković et al., 2018). *L. angustifolia* is also a very popular aromatic plant and is widely used in perfumes, cosmetics and medicines (Tang et al., 2017). Borneol (22.4%), epi-α-muurolol (13.4%), α-bisabolol (13.1%), precocene I (13.0%), and eucalyptol (7.9%) are the major essential

oil constituents (Mantovani et al., 2013). Lavandunat, lavandufurandiol, lavandufluoren lavandupyrones A and B and five known compounds 4- (1-hydroxy-1-methylethyl) benzoic acid, methyl 3- (3,4-dihydroxyphenyl) propanoate, 3,4, α-trihydroxyl-ethyl phenylpropionate, rosmarinic acid and isosalvianolic acid are primary phenolic compounds (Yadikar et al., 2018).

Nowadays, since the safety of synthetic antioxidants is questioned in edible oils, the addition of natural antioxidants is recommended. This is one of the aims of our study and to determine whether the plants in question will be used for this purpose. In addition, the antioxidant and phenolic content of these plants is compared with each other. There are studies on these plants in the literature and there is no comparison under the same experimental conditions. This is one of the factors that make up the originality of our study. The antioxidant test of these plants in edible oils by Rancimat method is another of our original values.

2. Material and Methods

2.1. Plant Extraction

Plants harvested from Afyonkarahisar Medicinal and Aromatic Plants Center in 2018. All analyses were done at the same year. The plants were dried at 37°C for 72 hours and then prepared for analysis. 0.1 g plant samples were kept in 20 ml of methyl alcohol for 2 hours and the solution was filtered through ordinary filter paper. The resulting solutions were used for DPPH and total phenolic analysis. Total antioxidant and total phenolic analyzes were performed in three replicates and the average of the experimental results were given.

2.2. Detection of Free Radical Scavenging Activity

Total antioxidant test DPPH method was used with some modifications of antioxidant determination of *M. piperita*, *S. officinalis*, *R. officinalis* and *L. angustifolia* (Blois, 1958; Brand-Williams et al., 1995). Accordingly, 1 ml of plant extracts were mixed with 1 ml of 0.002 g / 100 ml DPPH (in methanol). The resulting solution incubated in dark for 30 minute and the absorbance of each sample mixture was measured at 517 nm. 1 ml of DPPH solution with 1 ml of methyl alcohol was mixed and read at 517 nm at 0 minutes and recorded as a control. Methyl alcohol solution was evaluated as a blank sample. The percentage of Radical scavenging activity was calculated using this formula % Radical scavenging activity = (Absorbance control-Absorbance sample) x100 / Absorbance control equation.

2.3. Total Phenolic Content Analysis

The total phenol content in *M. piperita*, *S. officinalis*, *R. officinalis* and *L. angustifolia* was calculated according to the Folin-Ciocalteu method (Singleton et al., 1965). Five different concentrations of 0.0312-0.125-0.25-0.5-1mg / ml of gallic acid were prepared with 99.9% methanol. 20 µl of this solution was taken and 680µl of distilled water, 400µl of 0.5 N folin reagent (in water), 400µl of 10% Na_2CO_3 (in water) were added and absorbance at 760nm wavelength were read. In addition, 700 µl distilled water, 400µl 0.5 N folin reagent, 400µl 10% Na_2CO_3 was mixed as the blank sample and the absorbance values from the blank sample was reset for samples and standard samples. From the data, graph of absorption versus concentration was obtained which is regression coefficient 0.95. 20 µl of the extracted plant solution mixed with 680 µl of distilled water, 400 µl of 0.5 N folin reagent, 400 µl of 10% Na_2CO_3 and the absorbance values were measured at 760 nm after 30 minutes. In the obtained equation, the absorbance values replaced by y and the x values were calculated. When the x multiply by the dilution factor phenolic equivalents in terms of gallic acid was calculated.

2.4. Rancimat Analysis

Rancimat analyzes were performed according to the standard rancimat method. In this method, the temperature is 120 ° C, the sample amount is 3 g, the air flow is 20 L / h, and the water amount is 60 mL. 0.055 µs ultra-pure water was used in the experiments. Extra virgin olive oil produced in 2018 was used as oil. Since there is no standard for these plants for use as an antioxidant in edible oils, they were added to olive oil in 2% ratio and kept for 24 hours. Rancimat analysis results were compared in its pure form. The experiments were performed in two replicates and the average of the test results were given.

3. Results

3.1. % Radical Scavenging Activity

Data obtained as a result of DPPH experiments were given in Table 1. When the radical scavenging activity values of the plants are examined, it was observed that *M. piperita* was the highest with 95.31% radical scavenging activity and it was followed by *S. officinalis* with 91.83%. In terms of antioxidant content, the lowest *L. angustifolia* was found to be 18.85% under the same conditions. The radical scavenging activity of *R. officinalis* was tested as 54.28%.

3.2. Phenolic Content

The absorption concentration graph of the gallic acid standard formed according to the folin-ciocelteu method was given in Figure 1. The phenolic equivalents of the plants in terms of gallic acid were given in Table 2.

Table 1. % Radical scavenging activities of plant materials

Plant materials name	% Radical scavenging activity
M. piperita	95.31
S. officinalis	91.83
R. officinalis	54.28
L. angustifolia	18.85

Table 2. Phenolic content of plants in terms of gallic acid (mg / 100ml)

Plant materials name	The phenolic equivalents of the plants in terms of gallic acid mg/100ml
M. piperita	0.32
S. officinalis	0.28
R. officinalis	0.26
L. angustifolia	0.18

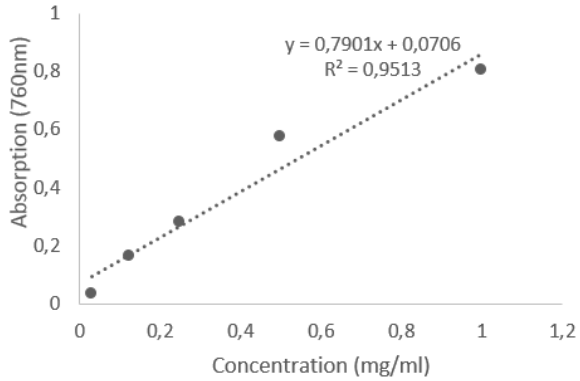

Figure 1. Absorption- concentration graph of five different concentrations of gallic acid methanol solution at 760 nm.

3.3. Rancimat Results

In Table 3, the induction periods obtained as a result of rancimat analysis were given.

From the data, adding these plants to virgin olive oils increased oxidation stability of virgin olive oil. While virgin olives induction period was 5.68, *L. angustifolia* added virgin olive oil was 5.90, *R. officinalis* added virgin olive oil was 6.63, *S. officinalis* added virgin olive oil was 6.07, and *M. piperita* added virgin olive oil was 6.43.

Table 3. Induction periods of olive oil and olive oil with 2% plant additive obtained by rancimat device

Plant materials name	Average
M. piperita	6.43±0.07
S. officinalis	6.07±0.01
R. officinalis	6.63±0.14
L. angustifolia	5.90±0.00
Virgin Olive Oil	5.68±0.16

4. Discussion

In this study, these four different plants were evaluated comparatively in terms of % radical scavenging activity, phenolic analysis, and effects of olive oil on oxidation stability. *M. piperita*'s % radical scavenging activity was 95.31%, *S. officinalis*'s 91.83%, *R. officinalis*'s 54.28%, and *L. angustifolia*'s 18.85%. *M. piperita* is the highest with 0.32 mg/100ml in terms of gallic acid. The *M. piperita* plant was followed by *S. officinalis* 0.28 *R. officinalis* 0.26 and *L. angustifolia* 0.18 mg/100ml, respectively. The total phenolic content of the *S. officinalis* leaves was calculated as 0.324g 100g-1 in terms of caffeic acid (Türk Baydir et al., 2021). In a scientific study, it was observed that *S. officinalis* was higher in terms of antioxidant and total phenolic content compared to *R. officinalis* (Armatu et al., 2010). According to the results of another study, *S. officinalis* is rich in myricetin and p-coumaric acid, while *R. officinalis* is rich in components such as rutin catechin quercetin (Bianchin et al., 2020). Extra virgin olive oil deteriorates at 120 °C in about 5.68 hours, 5.90 hours when 2% lavender was added, 6.07 hours when sage was added in, 6.63 hours when rosemary was added, 6.43 hours when mint was added. As a result, it was concluded that these plants can be used as anti-oxidation or retardant of extra virgin olive oil oxidation. The effect of *L. angustifolia* on oxidation stability of olive oil was the lowest as in all analyzes and the order of other plants had changed. In a study, it was determined with the help of the rancimat device that sage prevented oxidation in sunflower oil more than rosemary. This situation contradicts with the results of our study and we attribute this situation to regional factors (Upadhyay and Mishra, 2014). The toxicity of these plants was not emphasized in this study. Considering this situation, it is recommended to establish a standard and use it as a natural antioxidant in extra virgin olive oil. In addition, the effects of other cooking oils on oxidation stability can also be studied.

Author Contributions

All tasks have been done by the single author. The author reviewed and approved the manuscript.

Conflict of Interest

The author declared that there is no conflict of interest.

References

Armatu A, Colceru-Mihul S, Bubueanu C, Draghici E, Pirvu L. 2010. Evaluation of antioxidant and free scavenging potential of some Lamiaceae species growing in Romania. Romanian Biotech Lett, 15(3): 5274-5280.

Bianchin M, Pereira D, Almeida JF, Moura C, Pinheiro RS, Heldt LFS, Haminiuk CWI, Carpes ST. 2020. Antioxidant properties of lyophilized rosemary and sage extracts and its effect to prevent lipid oxidation in poultry pâtê. Molecules (Basel, Switzerland), 25(21): 1-10.

Blažeković B, Yang W, Wang Y, Li C, Kindl M, Pepeljnjak S, Vladimir-Knežević S. 2018. Chemical composition, antimicrobial and antioxidant activities of essential oils of Lavandula × intermedia 'Budrovka' and L. angustifolia cultivated in Croatia. Indust Crops and Products, 123: 173-182. DOI: 10.1016/j.indcrop.2018.06.041.

Blois MS. 1958. Antioxidant determinations by the use of a stable free radical. Nature, 181: 1199-1200.

Brand-Williams W, Cuvelier ME, Berset C. 1995. Use of a free radical method to evaluate antioxidant activity. Lebensm-Wiss u-Technol, 30(28): 25-30.

Desam NR, Al-Rajab AJ, Sharma M, Mylabathula MM, Gowkanapalli RR, Albratty M. 2019. Chemical constituents, in vitro antibacterial and antifungal activity of Mentha×Piperita L. (peppermint) essential oils. J King Saud Univ Sci, 31(4):

528-533.

Dıraman H, Baydır AT. 2017. Yağların oksidasyon kararlılıklarının tespit edilmesinde kullanılan hızlandırılmış stabilite metotları ve bu metotların karşılaştırılması. Gıda ve Yem Bil Teknol Derg, 18(2): 34-41.

Dorman HJ, Koşar M, Başer KH. 2009. Phenolic profile and antioxidant evaluation of Mentha x piperita L. (peppermint) extracts. Nat Prod Commun, 4(4): 535-542.

Farnad N, Heidari R, Behnaz A. 2014. Phenolic composition and comparison of antioxidant activity of alcoholic extracts of Peppermint (Mentha piperita). J Food Measur Charact, 8(2): 113-121.

Ghorbani A, Esmaeilizadeh M. 2017. Pharmacological properties of Salvia officinalis and its components. J Trad and Complement Med, 7(4): 433-440.

Ilboudo O, Bonzi S, Tapsoba I, Somda I, Bonzi-Coulibaly YL. 2016. In vitro antifungal activity of flavonoid diglycosides of Mentha piperita and their oxime derivatives against two cereals fungi. Comptes Rendus Chimie, 19(7): 857-862. DOI: 10.1016/j.crci.2015.11.023.

Mantovani ALL, Vieira GPG, Cunha WR, Groppo M, Santos RA, Rodrigues V, Magalhães LG, Crotti AEM. 2013. Chemical composition, antischistosomal and cytotoxic effects of the essential oil of Lavandula angustifolia grown in Southeastern Brazil. Brazilian J Pharmac, 23(6): 877-884. DOI: 10.1590/S0102-695X2013000600004.

Ribeiro-Santos R, Carvalho-Costa D, Cavaleiro C, Costa HS, Albuquerque TG, Castilho MC, Ramos F, Melo NR, Sanches-Silva A. 2015. A novel insight on an ancient aromatic plant: The rosemary (Rosmarinus officinalis L.). Trends in Food Sci Technol, 45(2): 355-368. DOI: 10.1016/j.tifs.2015.07.015.

Singh R, Shushni MAM, Belkheir A. 2015. Antibacterial and antioxidant activities of Mentha piperita L. Arabian J Chem, 8(3): 322-328. DOI: 10.1016/j.arabjc.2011.01.019.

Singleton VL, Rossi JA. 1965. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American J Enology and Viticult, 16(3): 144-158.

Slinkard K, Singleton V. 1977. Total phenol analysis: Automation and comparison with manual methods. American J Enology and Viticult, 28: 49–55.

Tang S, Shi J, Liu C, Zhang F, Xiang N, Liu X, Chen Y, You J, Shen Q, Miao M, Liu Z, Yang G. 2017. Three new arylbenzofurans from Lavandula angustifolia and their bioactivities. Phytochem Lett, 19: 60-63. DOI: 10.1016/j.phytol.2016.12.005.

Tsai ML, Wu CT, Lin TF, Lin WC, Huang YC, Yang CH. 2013. Chemical composition and biological properties of essential oils of two mint species. Trop J Pharm Res, 12: 572-582.

Türk Baydir A, Soltanbeigi A, Canlidinç RS, Selçuk M. 2021. Determination of chemical properties and antioxidant effect of Salvia Officinalis L, 4(1): 95-100.

Upadhyay R, Mishra HN. 2014. Antioxidant activity measurement of oleoresin from rosemary and sage. Indust Crops and Prod, 61: 453-459. DOI: 10.1016/j.indcrop.2014.07.043.

Yadikar N, Bobakulov K, Li G, Aisa HA. 2018. Seven new phenolic compounds from Lavandula angustifolia. Phytochem Lett, 23: 149-154. DOI: 10.1016/j.phytol.2017.12.005.