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Determination of Antibacterial and Antioxidant Potential of Some Medicinal Plants

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ABSTRACT

Myrtaceae family is one of the most famous plant families; we chose three plants which are *Syzygium aromaticum*, *Myrtus communis* and *Psidium guajava*, to clarify antioxidant and antibacterial activities. The results showed that, the highest percentage of total phenols and tannins in *Syzygium aromaticum buds* extract, and followed by *Myrtus communis* leaf extract and finally *Psidium guajava* leaf extract. The percentages of total flavonoids reached their maximum values in *Syzygium aromaticum* extract (10.4 %), followed by *Psidium guajava* leaves (5.5 %), and decreased to the lowest concentration in *Myrtus communis* leaves (4. 1%). The antioxidant study revealed that, *Syzygium aromaticum*, *Myrtus communi* and *Psidium guajava* plants have high antioxidant activity due to their ability to capture free radicals. The antimicrobial study demonstrated that, the three plant extract have antimicrobial effects against many pathogenic bacterial strains. Therefore, it is recommended to use the three plants under studied as antioxidant and antibacterial.

Keywords: Myrtaceae, *Psidium, Myrtus, Psidium,* Phenols, Flavonoids, Tannins, Antioxidant, Antibacterial.

1. Introduction

The pharmaceutical industry in our Arab world forces us to rethink with a holistic view of the importance of returning to nature, and making use of its botanical treasures. About three quarters of the world's population still depends on plants and their extracts for health care (Semwal *et al.,* 2015). These plants are the source of these effective compounds with less toxicity that can be used to treat different types of infectious diseases (Pinheiro *et al.,* 2017). The use of plants and its derivative products for medical purposes represents a practice in increasing expansion at the present time. This practice is based primarily on the popular knowledge, passed from generation to generation, but has been incorporating scientific advances in the search to guarantee security using plant species with proven therapeutic efficacy (Barroso *et al., 2018*).

Condiments are used worldwide to increase and/or add flavor to food and for conservation purposes, due to its antimicrobial and antioxidant properties. Among the plants commonly used, especially in Arab societies, many plants that belong to the family Myrtaceae, including *Syzygium aromaticum*, *Myrtus communis* and *Psidium guajava* plants, which had the greatest share in being chosen to complete their studies with our research because of their importance in the field of folk medicine.

The Syzygium aromaticumplant contains many effective chemical compounds, including phenols, resins, saponins, tannins, flavones, glycosides and alkaloids, in addition to Eugenol, Caffeic acid, Kaempferol, Vanillin, Ferulic acid, Ellagic acid, Chlorogenic acid. Recently, Syzygium aromaticumplant extract is considered to be antifungal, antibacterial, and antioxidant (Chaula *et al.,* 2019 and Oluwasina *et al.,* 2019). The aqueous extract has been shown to have a broad effect against

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Staphylococcus aureus (Khadir *et al.,* 2018). The plant extract also has an effect against oral pathogenic microorganisms (Oluwasina *et al.,* 2019). It was used in previous centuries as a topical analgesic in dentistry because it contains special substances for anesthesia, and it has also been used successfully for asthma and various oral sensitivity disorders and in the perfume and soap industry (Mittal *et al.,* 2014).

Several scientists have proven that *Myrtus communis* leaf extracts contain antioxidants, and The protective effect of the myrtle berry seed aqueous extract against esophageal reflux induced damage in esophagus mucosa as well as the mechanisms implicated was determined. The results showed, also, that the esophageal reflux was accompanied by a state of oxidative stress as assessed by an increase of lipid peroxidation, a decrease of the sulphhydryl groups and glutathione levels, as well as antioxidant enzyme activities depletion. It suggests that myrtle berry seed aqueous extract exerted a potential protective effect against esophageal reflux induced damage in rat esophagus, at least in part, due to its antioxidant properties (Miraj and Kiani, 2016). It has also been proven that the plant is used in the food industry. Ripe fruits are rich in vitamins and are added to some foods to give flavor, as it is included in the compounds that make up the chewing gum (Akin *et al.,* 2010).

Recent studies confirmed that the extracts of the different parts of the *Psidium guajava* plant contain many active substances, including flavonoids, terpenes, tannins, saponins, phenols, anthraquinones and alkaloids, while the amino acids and proteins are absent (Mishra *et al.,* 2017). There is also oleanolic acid in *Psidium guajava* leaves, which has a high content of limonene, about 42.1%, and carbophylline, about 21.3%. Terpenine and benin are also found in the aqueous extract of the *Psidium guajava* leaves, which are also antimicrobials (Sumra *et al.,* 2018). And recently, the inhibitory ability of *Psidium guajava* leaf extracts has been demonstrated on some strains of bacteria, including *S. aureus*, *Psudomonas aeruginosa* and *E. coli* (Mailoa *et al.,* 2014). The leaves of the plant have also been used in traditional medicine for diabetes, cardiovascular disease, cancer and parasitic infections (Díaz-de-Cerio *et al.,* 2017).

2. Material & Method

2.1. Extracts:

Whole plant Samples were soaked separately with ethyl alcohol 70% in conical flasks for 24 h at 40°C on water bath. After 24 hours it was filtered with Whatman No.1 filter paper. The filtrates were evaporated with rotary evaporator apparatus to obtained extraction for each sample. The extracts were stored in sample bottles at 4°C prior to use for further analyses.

2.2. Determination of Total Phenolic Content (TPC):

The total phenolic content for all plant samples was determined by using Folin- Ciocalteu method (Odabasoglu, *et al.,* 2004).

2.3. Determination of Total Flavonoids (TFC):

The total flavonoids content for all plant samples was determined was estimated according to Odabasoglu, *et al.,* (2004).

2.4. Determination of Total Tannins (TTC):

The total tannins content for all plant samples was determined was estimated according to Ali, *et al.,* (1991).

2.5. Antioxidant Scavenging Activity (DPPH) Assay:

The effect of methanolic extracts on DPPH (2,2- diphenyl-1-picrylhydrazyl) radicals was estimated according to Gardeli, *et al.,* (2008).

2.6. Antimicrobial activities:

The tested microorganisms included the following bacteria: *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, E. coli & Klebsiella pneumoniae,* were used in Disk-diffusion assay according to the protocol described by Hajlaoui *et al.* (2009).

3. Results and Discussion

3.1. Determination of Total Phenolic Content (TPC):

From the quantitative estimation of the total phenolic content of the plant samples being studied as shown in table (1), the highest percentage of total phenols in *Syzygium aromaticum buds* extract, and followed by *Myrtus communis* leaf extract and finally *Psidium guajava* leaf extract (8.0, 7.4 & 7.2 %, respectively).

Table 1: Determination of total active materials for the plant extracts

	Syzygium aromaticum %	*Myrtus communis %*	*Psidium guajava %*
Total Phenolics %	8.00	7.40	7.20
Total Flavonoids %	10.40	4.10	5.50
Total Tannins %	5.23	2.20	2.19
IC_{50} antioxidant µg/ml	90.8	90.8	90.1

3.2. Determination of Total Flavonoid (TFC):

Total flavonoids present in different studied plant extracts were determined spectrophotometrically and calculated. From table (1), The percentages of total flavonoids reached their maximum values in *Syzygium aromaticum* extract (10.4 %), followed by *Psidium guajava* leaves (5.5 %), and decreased to the lowest concentration in *Myrtus communis* leaves (4. 1%).

3.3. Determination of Total Tannins (TTC):

By looking at the percentage of total tannins in plant extracts of plants belonging to the Myrtaceae family as shown in Table (1), we found that the proportions were high and close, as they were highest in *Syzygium aromaticum* seed extracts (5.23%), followed by *Myrtus communi* leaves (2,20%), then leaves *Psidium guajava* plants (2,19%).

3.4. Antioxidant Scavenging Activity (DPPH) Assay:

The IC_{50} values as shown in table 1, where it was found that the buds of the *Syzygium aromaticum* plant, and the leaves of the *Myrtus communi* followed directly by the leaves of the *Psidium guajava* plants, have high antioxidant activity due to its ability to capture free radicals, where it was 90.8; 90.0 &90.1%, each of them respectively.

3.5. Antimicrobial activities:

The initial detection of the extracts of the studied plants was done as antimicrobials on five strains of pathogenic bacteria as shown in table (2). Effectiveness was given and the inhibition diameter was measured for four types, *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, E. coli & Klebsiella pneumoniae*. From the obtained results, we find the effectiveness of these extracts on *Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis* & *E. coli* and no effectiveness was given on *Klebsiella pneumonia* bacteria.

Considering the effectiveness of the *Syzygium aromaticum* leaf extract on the four pathogenic bacterial strains, we find that it reached to maximum inhibition zoon on *Staphylococcus epidermidis*, and gradually reduced to the lowest rate of effect in the *Psidium guajava* leaf extract

Myrtus communis leaf extract also have inhibition effects against *Staphylococcus aureus and followed by Staphylococcus epidermidis* (22 & 21 mm, respectively) and then reduced by *Proteus mirabilis & E. coli* (10 mm, for both) of inhibition zone diameter.

Psidium guajava leave extract have also high effects on *Staphylococcus aureus & Staphylococcus epidermidis* bacteria with inhibition zone 18 mm, and it's have not effect on other bacterial studied strains.

According the data on table (1 & 2), the phenolic substances, flavonoids and tannin content, in the buds of the *Syzygium aromaticum* plant is about 8.00; 10.40 & 5.23% respectively, and upon returning to the results of the detection of the effectiveness of this plant as an antioxidant according to its ability to capture free radicals, it was estimated at 90.8%. The ability of these compounds to prevent oxidation and resist free radicals, which play the most important role in the development of many

dangerous diseases such as cancer and arterial blockage, as well as anti-inflammatory and diabetes mellitus, these results are in agreement with that obtained by Chaula *et al.,* (2019) and Oluwasina *et al.,* (2019). And also, this extract has antimicrobial efficacy for many pathogenic bacteria (*Staphylococcus aureus, Staphylococcus epidermidis, Proteus mirabilis, E. coli & Klebsiella pneumoniae* with an inhibition zone 21, 14, 24, and 19 mm each, respectively) according to the high concentrations of phenolic, tannin and flavonoids present in extract, these results are in agreement with that obtained by Chaula *et al.,* (2019); Oluwasina *et al.,* (2019) and Khadir *et al.,* (2018).

Table 2: Antimicrobial activities for the plant extracts

Plant extract / Bacteria strains	Inhibition zone (mm)		
	Syzygium aromaticum	***Myrtus communis***	***Psidium guajava***
Staphylococcus aureus	21	22	18
Staphylococcus epidermidis	24	21	18
Proteus mirabilis	19	10	-ve
Escherichia coli	14	10	-ve
Klebsiella pneumoniae	-ve	-ve	-ve

According to the data on table (1 & 2), *Myrtus communis* leaves extract contain high percentages of tannins, phenols and flavonoids (2.20; 7.40 & 4.10 %, respectively) and this extract has a high antioxidant capacity (8,90%) and this is confirmed by previous studies where it was proven that the essential oil of *Myrtus communis* plant has the ability to reduce the oxidation of DPPH due to its containment of monoprotein hydrocarbons and these compounds have high activity in antioxidants and , these results are in agreement with that obtained by Miraj and Kiani (2016). The importance of the *Myrtus communis* plant as an antioxidant and an antagonist to many types of bacteria and fungi in addition to its use as an anti-inflammatory and that the plant extracts are used in a wide field in folk medicine is due to the secondary active substances contained in the leaves of this plant, these results are in agreement with that obtained by Alwan, (2017) and Gortzi *et al.,* (2007).

The *Myrtus communis* plant extract has an antibacterial effect for all types of bacteria, except for *Klebsiella pneumoniae*, which did not affect it, and this result is in agreement with what was mentioned in previous studies (Shahla *et al.,* 2006). It is may be due to a number of active substances presented in the extract that have the ability to penetrate and spread through the cell wall of germs, and, these results are in agreement with that obtained by Al-Ma'adydi and Mahmood (2016).

On the other hand, the phenolic substances, flavonoids and tannin content, in *Psidium guajava* leaf extracts is about 7.20; 5.50 & 2.19% respectively, and upon returning to the results of the detection of the effectiveness of this plant as an antioxidant and, these results are in agreement with that obtained by Mishra *et al.,* (2017) and Barbalho *et al.,* (2012). *Psidium guajava* plant extract has active substances play an important role in many biological and microbial activities and inhibit the growth of some bacterial strains, including *Staphylococcus epidermidis* and *Staphylococcus aureus*, where the inhibitory diameter was 18 mm in both strains. This results are in agreement with that obtained by Kaflr *et al.,* (2018) and Mailoa *et al.,* (2014).

4. Conclusion

The results of the research showed that the content of active substances in the plants under study is very high, the highest were the buds extract of *Syzygium aromaticum* plant and the leaves of the *Myrtus communis* plant, and the least of them were the leaves extract of *Psidium guajava* plant. The extract of the three plants have antioxidant and antibacterial effect. Therefore, I recommend using the three plant extracts as antioxidant plants and effective against many pathogenic bacterial strains.

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