Broad-Spectrum Antibacterial Activity of the Buds Rosa Damascena Bud Extracts Against Pathogens Isolated Clinically

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Abstract: We present the chemical composition of the flower buds of Rosa damascena, as well as their inhibitory activity against pathogenic Gram-positive and Gram-negative bacterial strains. GC-MS analysis for the Detection of bioactive compounds in Rose Damascena buds and isolation of bacteria by using the Vitek 2 system. Evaluate the antibacterial activity of water and ethanolic extracts on multidrug-resistant strains. Assess the activity of both extracts also on bacterial growth inhibition. Methods: Preparation of Extracts: The flower buds (including calyx leaves, petals, stamens, and receptacles) were ground and extracted with water (aqueous) and ethanol (ethanolic). Antibacterial Assays: Tested extracts against seven bacterial strains using agar well diffusion method: Gram-positive: Staphylococcus aureus, Gram-negative: Escherichia coli, Klebsiella pneumoniae, Serratia, Pseudomonas aeruginosa, Proteus spp., Acinetobacter baumannii. Concentrations tested: Aqueous (15–50 mg/mL), Ethanolic (25–100 mg/mL). Bioactive Compound Profile: Bioactive compounds were identified by GC-MS. Results: The Inhibitory Activity: Ethanolic extract: Exhibited substantial inhibition against S. aureus, Serratia, and P. aeruginosa at all tested concentrations. Aqueous extract: More effective than ethanolic extract on K. pneumoniae and Proteus spp. (15–50 mg/mL). Strains that were not responsive: Both extracts did not affect A. baumannii. Isolates of E. coli were partially resistant, where one isolate was sensitive to ethanolic extract and another to aqueous extract. Chemical Composition: GC-MS analysis shows bioactive compounds such as 2,3-Butanediol, Oxirane,2,3-dimethyl and 6-Oxa-bicyclo[3.1.0]hexan-3-one are probably responsible for different antimicrobial activities. Conclusion: Rosa damascena buds are a reservoir of effective bioactive substances and have significant antibacterial potential, especially against S. aureus and P. aeruginosa. However, resistance seen in strains such as A. baumannii highlights the necessity for additional research to improve extraction strategies or to pair the active compounds with traditional antibiotics. The findings highlight the plant as a promising source of natural antimicrobials in the fight against antibiotic resistance.

1 INTRODUCTION

Medicinal plants play an important role in human life, as they are a rich source of active organic compounds and molecules that have been used as medicines or as important sources for drug discovery and design. Many studies have demonstrated the efficacy and safety of medicinal herbs in treating most human diseases, and some of these studies have revealed the molecular mechanisms behind the significant health benefits of medicinal plant drugs. However, some topics require further research, such as identifying and determining the active biological components, assessing the stability of these active substances, and evaluating their pharmacological efficacy [1]. The excessive use of antibiotics is a major problem that has led to the emergence of bacterial strains resistant to these antibiotics.

Therefore, it is necessary to find various methods, including referring to products manufactured from medicinal plants that have antibacterial efficacy and can reduce resistant bacterial strains [2]. Maintaining blood sugar levels is attributed to plant secondary metabolic products that are important in eliminating inflammation and have been used to treat many diseases such as coughs, colds, digestive system diseases, and pharyngitis, as these products serve as a sedative, antispasmodic, and a significant immune stimulant [3]. Roses have been used for many purposes, including food, perfumes, and decoration. They have been cultivated throughout the ages. The most important of these roses is the Damask rose. It is distinguished by its pink or red colour and belongs to the rose family. It contains volatile oils that have been used in the perfume industry and the production of rose water [3]. The petals of the Damask rose contain gallic acid, flavonoids, phenols, anthocyanins, and beta-citronellas. Geraniol, in addition to antioxidants that are more than those found in green tea leaves, terpenes and glycosides, plants have antimicrobial, antibacterial, antiviral, anticancer and anti-inflammatory effects, used as a pain reliever, sedative and hypnotic, and if they contain terpenes and glycosides that have a beneficial effect on the body in treating eye diseases, it was also used in treating many diseases of the digestive system such as constipation as a laxative, and it showed an effect against depression, Alzheimer's and dysmenorrhea.

Before the introduction of antibiotics, the genes of bacterial resistance to antibiotics were very low. Over the past ten years, bacterial resistance to antibiotics has gradually accelerated since the first day of using these antibiotics. To reduce antibiotic resistance, the use of these antibiotics must be reduced, and other alternatives must be found, as the spread of infectious diseases poses a serious threat to public health, especially Gram-negative and Gram-positive bacterial species [4]. In the early 1940s, the miracle of penicillin had a remarkable impact on public health, saving many people from death due to infections and opening wide horizons for complex operations and the treatment of chronic diseases. However, the increasing resistance of bacteria, represented by Gram-positive and Gram-negative bacteria such as Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella spp., and others that cause various infections and diseases, necessitates finding solutions and understanding different ways to combat this increasing resistance. Various sources and media have sounded the alarm that we are returning to the pre-antibiotic era, with the possibility that antibiotic resistance could cause many deaths by the year 2050 [5].To find alternatives that reduce the spread of antibiotic-resistant bacteria while being effective and a natural substitute, the flower buds of the plant Rosa damascenes were chosen, hoping they would be a promising alternative to antibiotics.

This study aims to evaluate the antibacterial activity of aqueous and alcoholic extracts from Rosa damascena flower buds against clinically relevant Gram-positive (Staphylococcus aureus) and Gram-negative pathogens (Escherichia coli, Pseudomonas aeruginosa, Klebsiella spp., Serratia spp., Proteus spp., Acinetobacter baumannii) isolated from surgical and traumatic wounds, while identifying bioactive compounds via GC-MS analysis. Key objectives include determining the inhibitory efficacy of the extracts against these multidrug-resistant strains, characterizing phytochemical constituents, and assessing synergistic interactions between the extracts and commonly prescribed antibiotics to enhance clinical treatment strategies.

2 MATERIALS AND METHODS

2.1 Bacterial Samples

The Forty samples were collected from various sites and different parts of the body from patients at a private laboratory in Najaf Province after obtaining their consent. The samples were then cultured on media such as nutrient agar and MacConkey agar in Petri dishes, and incubated overnight at 37ºC in the incubator. After the incubation period, the plates were examined to identify bacterial growth, with distinctive growth patterns and colours recorded to assist in identifying potential microbial species. Additional tests were conducted to confirm the biological identity of the isolated bacteria [6]

2.2 Diagnosis of Bacterial Isolates

2.2.1 Culture Medium

To use the culture, Mueller-Hinton agar was used to isolate bacteria, and Nutrient broth was used to preserve and activate the isolated bacteria. All culture media were prepared according to the instructions of the manufacturers [7], and their pH was adjusted. The media were then sterilized with an autoclave for 15 minutes at 121°C and under pressure and used the Vitek 2 system (ANC Kit, bio Merieux) and aerobic control.

2.2.2 Microscopic Diagnosis

After examining the bacterial colonies growing in the solid Nutrient agar medium, casting them with a cram dye, and examining them with an electron microscope with a 1000 x oil lens, the microscopic field of the dyed slide showed cluster colonies dyed with crystal violet dye.

2.2.2.1 Preparation of Ethanol Extract from Rosa Damascenes’ Flower Buds

Dried rose buds were processed in an electric grinder, ensuring that the entire bud - comprising sepals, petals, stamens, and pistil - was ground. A quantity of 250 g of the resulting powder was measured and placed in a Soxhlet extraction apparatus with a mixture of 75 ml of 99% ethanol and 25 ml of distilled water, maintained at a temperature of 45°C. After the extraction, the resulting solution was dried with a rotary evaporator, weighed, and various concentrations were prepared through dilution and stored in a refrigerator at 4°C.

2.2.2.2 Preparation of Hot Water Extract from Rosa Damascenes’ Flower Buds

The entire flower bud (petals, sepals, stamens, and receptacle) was ground, and 30 grams of the dry powder was mixed with 200 millilitres of hot distilled water. The mixture was placed in a shaking water bath at 100 RPM at a temperature of 45°C for four hours.

Using sterile medical gauze, the plant extract was filtered, the filtrate was placed in a centrifuge for 10 minutes at a speed of 3000 rpm, then sterilized using a Milli Power Filter with a diameter of (0.45) micrometres, then diluted to different concentrations using the dilution law [5]. Which involve

$$C1*V1=C28*V2.$$

The inhibitory activity was studied by the diffusion method on the surface of Mueller-Hinton agar medium, and according to the McFarland tube at a dilution of (1.5×10^{8}) cells/ml, Gram-positive and Gram-negative bacterial isolates were cultured. Small holes with a diameter of 6 mm were made in the middle of the agar after leaving the cultured plates for ten minutes at room temperature. Different concentrations of Damask rose extract were added to the holes and the negative control hole containing distilled water. The plates were incubated for 24 hours at a temperature of 37 °C [8].

The Rosa damascenes used different concentrations of extract that were added to the wells, along with a positive control well containing distilled water.

3 RESULTS AND DISCUSSION

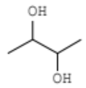
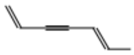
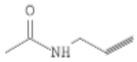
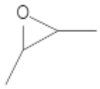
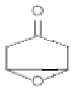
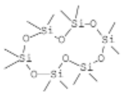
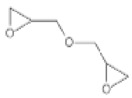
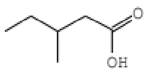
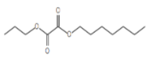
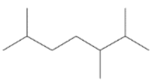
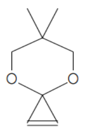
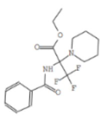
3.1 GCMS Analysis of Ethanolic Extract for Detection of Active Ingredients in Flower Buds of Damask Rose

Using a GCMS device, the active ingredients in the flower buds of the Damask rose were detected at the Environment and Water Directorate, Environmental Research Center. Ethanol was used as an organic solvent, and the results showed that the extract contained natural chemical substances represented by 2,3-butanediol, 1,5-heptadien-3-yne, acetamide, N-2-propynyl, oxirane, 2,3-dimethyl, and 6-oxa-bicyclo [3.1.0] hexan-3-one. Additionally, dodecamethy licyclohexasiloxane, 2-pentanol, 4,4-dimethylpentanoic acid, 3-methyl isoamyl nitrite, oxalic acid, heptyl propyl ester, heptane, 2,3,6-trimethyl, ethyl 2-benzamido-3,3,3-trifluoro-2-piperidinopropionate, and 4,8-dioxaspiro [2.5] oct-1-ene were also found, as shown in Table 1 and Figure 1.

Plants contain high concentrations of active biochemical compounds with antioxidant activity. It is known that free radicals cause autoxidation and that phenolic compounds with antioxidant activity depend on breaking the free radical chain by donating a hydrogen atom [9]. The petals of Rosa damascenes contain secondary metabolites that have antibacterial and antifungal effects and are considered oxidants against free radicals, as well as having soothing and anti-inflammatory properties. They are used as flavouring agents in food due to their content of various [10].

Essential oils [11]. It is used in the production of expensive rose oil, which is extracted through various commercial methods. Additionally, rose water has significant importance due to its soothing and comforting properties and is used on religious occasions in some countries [12]. Temperature is crucial for maintaining the quality of fruits and vegetables post-harvest, as it directly impacts their shelf life. Studies have shown that temperature fluctuations negatively affect plant quality [13].

Table 1: The natural components found in Rosa damascene rose buds.

	R.Time	Area%	
	2.94	2.75	Butanediol 2,3-
	7.61	1.84	1,5-Heptadien-3- yne
	8.151	20.66	Acetamide, N-2-propynyl
	8.7	2.18	Oxirane, 2,3-dimethyl
	10.135	3.54	6-Oxa-bicyclo[3.1.0]hexan-3-one
	10.761	1.62	Cyclohexasiloxane, dodecamethyl
	13.336	9.03	Oxirane, 2,2'-[oxybis(methylene)] bis
	15.042	3.42	Pentanoic acid, 3-methyl
	15.728	3.75	Isoamyl nitrite
	18.259	1.47	Oxalic acid, heptyl propyl ester
	20.572	7.83	2,3,6-Trimethyl - , heptane
	21.071	2.39	6,6-Dimethyl-4,8-dioxaspiro[2.5]oct-1-ene
	26.117	8.97	Ethyl 2-(benzoylamino)-3,3,3-trifluoro-2-(1-piperidinyl)propanoate

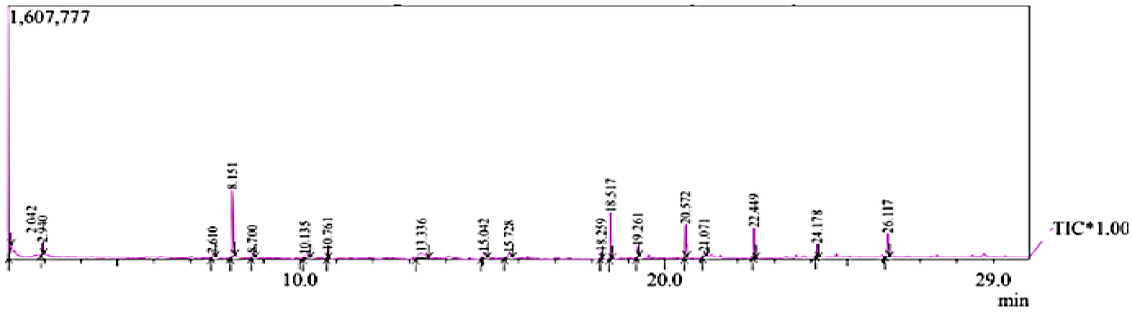


Figure 1: Chromatogram of extract of *Rosa damascenes'* GCMS (1-1).

Roses are among the most important ornamental plants, and their fruits and flowers have been used in a variety of traditional medicines and food products. They are considered significant oxidants due to their active compounds, particularly phenolics, with predominant quercetin and kaempferol glycosides [14]. A study conducted by [14, 15] showed a decrease in the viability of cancer cells when using *Rosa damascenes'* extract, depending on the concentration and duration of exposure, where the death of HeLa cancer cells was observed, indicating its potential as a promising therapeutic agent in the future. In addition to containing strong antioxidants, *Rosa damascenes* has shown activity against antibiotic-resistant bacteria, as the extracts were effective against a variety of Gram-positive and Gram-negative bacteria. The inhibitory activity is likely attributed to the presence of various phenolic and flavonoid compounds, which are believed to contribute to the antibacterial properties through bacterial growth inhibition tests. The numerous benefits resulting from the use of natural products rich in biologically active substances have enhanced the growing interest in the pharmaceutical, food, and cosmetic industries.

3.2 Spectrophotometer Ultraviolet (UV)

To analyze the UV spectra of the nanomaterial, a UV-Vis spectrometer (UV-1800, Shimadzu, Japan) was used. With a resolution of 1 nm, the absorption spectrometer was used in the laboratory.

Tests were conducted on the UV absorption spectra in the range of 200-300 nanometers for the alcoholic and aqueous extracts of the Damask rose plant. The preliminary study showed that the aqueous and alcoholic extracts of the Damask rose plant have a great ability to absorb ultraviolet rays effectively. This is because these extracts contain flavonoids, which are important substances used to protect the skin from the sun, as they are used in the manufacture of sunscreens.

2,3 Butanediol is an important industrial chemical found in the alcoholic extract of the Damask rose plant after detection of the natural components using GCMS. It is used in the production of pharmaceuticals, agricultural products and cosmetics. 2,3 Butanediol is a major secondary metabolite of many microorganisms, including both Gram-positive and Gram-negative bacteria. It exhibits anti-freezing, antibacterial, and anti-inflammatory properties and enhances natural defences [16].

3.3 The Effectiveness of the Aqueous Solution of Rose Flower Buds in Inhibiting Various Isolates of Gram-Negative and Gram-Positive Bacteria was Investigated by the Drilling Diffusion Method

The results showed that the aqueous solution of the flower buds of the rose plant "Rosa damascene" affected bacterial isolates, including *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella, Serratia, Proteus* spp. and *Acinetobacter Baumann*. After testing the efficiency of the isolates using the drill diffusion method, it was observed that the aqueous extract could inhibit the selected isolates, where Serratia bacteria recorded the highest inhibition rate, which ranged between 20-23 mm. Followed by the Staphylococcus aureus-1 isolate if the inhibition zones were 21-15 mm and in the *Pseudomonas aeruginosa* isolate, the inhibition zones were 12-17 mm and the *Escherichia coli*-2 isolate ranged between 0-17 mm. As for the remaining *Escherichia coli* isolates, the aqueous extract did not show any effect. *Klebsiella*-1, *Klebsiella*-2, *Proteus* and *Staphylococcus aureus*-2 showed varying effects ranging from 10-15 mm, 18-13 mm, 0-12 mm and 15-11 mm respectively, as the Inhibition zone increased with increasing concentration, except for one isolate, Klebsiella-2, which was affected by the low concentration, as shown in Table 2, Figure 2 and Figure 3.

The results of this study are similar to a previous study that indicated the aqueous extract of Rosa damascenes' flower buds has inhibitory activity against Staphylococcus aureus, while Escherichia coli was not affected by the aqueous extract of Rosa damascenes. Plants are a rich source of active compounds, which has led to increased interest in research related to them, especially due to the continuously growing popularity of treatments using plants with significant biological activity. A study shown by [17]showed that the aqueous extract of the Rosa damascene plant contains active compounds of great importance as natural antioxidants and antibacterial agents due to their inhibitory ability against many bacteria, including Micrococcus luteus, Staphylococcus aureus, Bacillus subtilis, Shigella Flexner, Proteus vulgaris, and Escherichia coli.

Staphylococcus aureus is a pathogen of soft tissues and skin causing bacteremia, bloodstream infections, arthritis, and pneumonia. It is a Gram-positive bacterium. Escherichia coli is a Gram-negative bacterium that contributes to the pathogenesis of intestinal and extraintestinal infections. It is an opportunistic pathogen, with some strains showing resistance to antibiotics due to the acquisition of virulence factors [18].

Pseudomonas aeruginosa is one of the most widespread bacteria and is the focus of intense research due to its prominent role in pathogenesis due to its relatively large genome, flexible metabolic capacity, and presence in diverse environments, it is an opportunistic bacterium that infects humans when natural immune defences are compromised, being particularly lethal in patients with cystic fibrosis and causing issues in patients with wounds, burns, chronic wounds, and those with pulmonary obstruction, especially in hospitalized patients. It is considered one of the antibiotic-resistant bacterial species, particularly to beta-lactam and aminoglycoside antibiotics. Its high ability to encode a range of resistance genes makes it difficult to treat [19].

Acinetobacter baumannii bacteria have shown resistance to drugs and pose a public health threat associated with high mortality rates due to acute infections, particularly hospital-acquired infections. Bacterial resistance to many drugs is linked to overuse, poor supervision, and overuse of antibiotics. Many bacteria are resistant, such as Gram-negative bacteria [15, 20]. Among these bacteria is Klebsiella pneumoniae, which has been shown by many studies to be particularly resistant to antibiotics, especially penicillin and others, as penicillin is not currently used. It is an opportunistic species that causes clinical infections, especially in hospitalized patients [21].

Table 2: The inhibition zones of the aqueous extract of Rosa damascenes' flower buds.

Concentrations / Type of bacterial isolation	Inhibition zones (mm) of aqueous extract of Rosa damascenes' buds (Mean ± S.D.)			
	50 (mlg/ml)	25 (mlg/ml)	23 (mlg/ml)	15 (mlg/ml)
Acinetobacter Baumann	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Escherichia coli-1	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Escherichia coli-2	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Escherichia coli-3	17 ± 1 a	11 ± 1 b	9 ± 1 c	0 ± 0 d
Klebsiella pneumoniae -1	15 ± 1 a	12 ± 1 bc	13 ± 1 b	10 ± 1 c
Klebsiella pneumoniae -2	13 ± 1 b	12 ± 1 b	12 ± 1 b	18 ± 1 a
Proteus	12 ± 1 a	10 ± 1 b	0 ± 0 c	0 ± 0 c
Pseudomonas aeruginosa	17 ± 1 a	12 ± 1 b	17 ± 1 a	12 ± 1 b
Serratia	23 ± 1 a	20 ± 1 b	21 ± 1 b	20 ± 1 b
Staphylococcus aureus-1	21 ± 1 a	15 ± 1 c	18 ± 1 b	15 ± 1 c
Staphylococcus aureus-2	14 ± 1 ab	13 ± 1 b	15 ± 1 a	11 ± 1 d

Groups with different letters are statistically different (p-value <= 0.05).
In each row:

- a: denote to the highest level,
- b: denote to the second highest level,
- c: denote to the third highest level,
- d: denote to the lowest level).

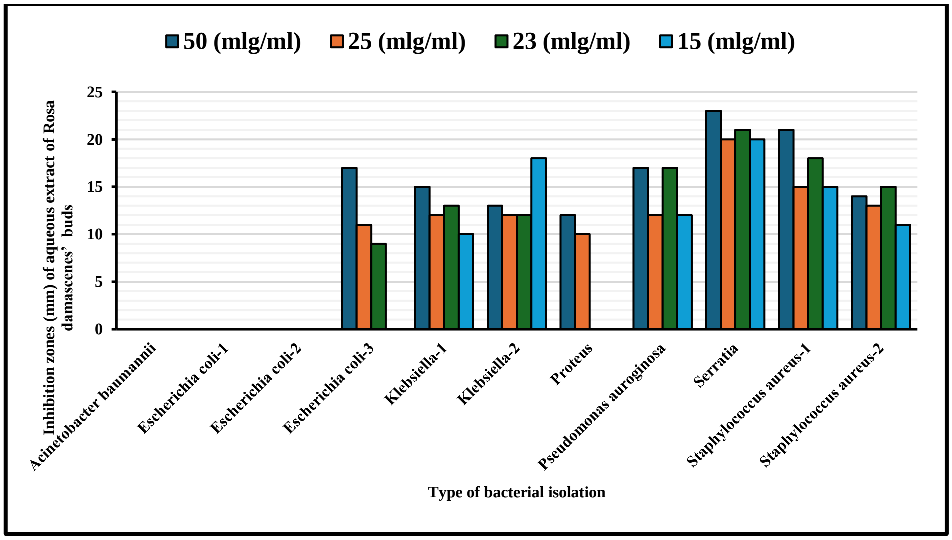


Figure 2: The inhibition zones of the aqueous solution of the flower buds of the Rosa damascene plant**.**

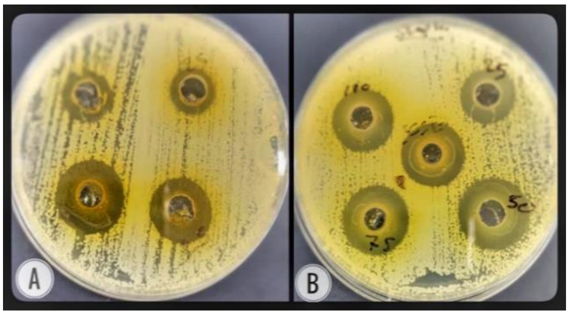


Figure 3: The effect of the plant extract on the flower buds of the Rosa damascene plant: a) is the effect of the aqueous extract on Staphylococcus aureus bacteria, and b) is the effect of the ethanolic alcoholic extract.

Also, among the types of bacteria is Serratia bacteria, which is classified as a common and harmful cause of diseases in hospitals and private clinics, as its presence is linked to medical devices and some methods of care provided to patients hospitalized in these places. This explains the large number of hospital infections resulting from these bacteria, especially S. marcescens. Hospital workers must be vigilant to prevent the spread of these diseases, which are considered opportunistic pathogens that affect insects, humans and animals. Given the significant resistance of bacteria to antibiotics. It is usually diagnosed in the clinical laboratory, but other rare types cannot be easily identified in laboratories [22]. Proteus.spp. Is a Gram-negative rod-shaped bacterium of the Enterobacteriaceae family that mainly causes urinary tract infections in humans. This bacterium can form biofilms in addition to primary bacteremia that may cause complicated bloodstream infections leading to infective endocarditis in addition to other diseases such as wound infections and respiratory tract infections [23].

3.3 Detection and Investigation of the Inhibitory Activity of Ethanolic Solution of Flower Buds of Rosa Damascene Against Different Isolates of Gram-Negative and Gram-Positive Bacteria by the Drilling Diffusion Method

This study showed that the inhibitory activity against *Staphylococcus aureus* bacteria was caused by the ethanolic extract of the flower buds of *Rosa damascene*, which ranged between 17-25 mm. This result was similar to what was mentioned by [24]. The highest effect of the extract was against Serratia bacteria with inhibition diameters ranging between 20-27 mm. As for *Pseudomonas aeruginosa* bacteria, it showed an effect of the extract, and the inhibition diameters ranged between 13-23 mm. The alcoholic extract did not show any effect against any of the bacteria *Proteus*, *Acinetobacter baumannii*, *Escherichia coli*-1, *Escherichia coli*-3, and *Klebsiella*-1, except for the *Escherichia coli*-2 isolate and the Klebsiella-2 isolate, which showed an effect, as shown in Table 3, Figure 4 and Figure 5.

Table 3: The inhibition zones of the ethanolic extract of *Rosa damascenes'* flower buds.

Concentrations Type of bacterial isolation	Inhibition zones (mm) of alcoholic ethanol extract of *Rosa damascenes'* buds (Mean ± S.D.)			
	50 (mlg/ml)	25 (mlg/ml)	23 (mlg/ml)	15 (mlg/ml)
Acinetobacter baumannii	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Escherichia coli-1	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Escherichia coli-2	20 ± 1 a	15 ± 1 b	10 ± 1 d	12 ± 1 c
Escherichia coli-3	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Klebsiella pneumoniae -1	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Klebsiella pneumoniae -2	10 ± 1 a	9 ± 1 b	0 ± 0 c	0 ± 0 c
Proteus	0 ± 0 a	0 ± 0 a	0 ± 0 a	0 ± 0 a
Pseudomonas auroginosa	23 ± 1 a	20 ± 1 a	18 ± 1 c	13 ± 1 d
Serratia	27 ± 1 a	23 ± 1 b	21 ± 1 c	20 ± 1 c
Staphylococcus aureus-1	25 ± 1 a	22 ± 1 b	22 ± 1 b	18 ± 1 c
Staphylococcus aureus-2	24 ± 1 a	21 ± 1 b	20 ± 1 b	17 ± 1 c

Groups with different letters are statistically different (p-value <= 0.05).
In each row:

- a: denote to the highest level,
- b: denote to the second highest level,
- c: denote to the third highest level,
- d: denote to the lowest level).

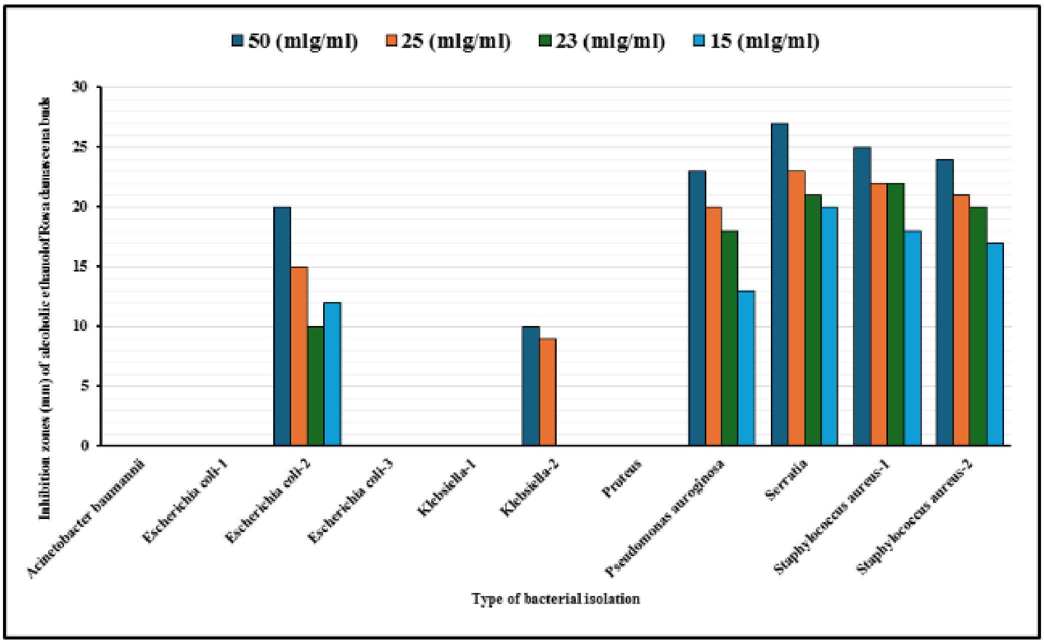
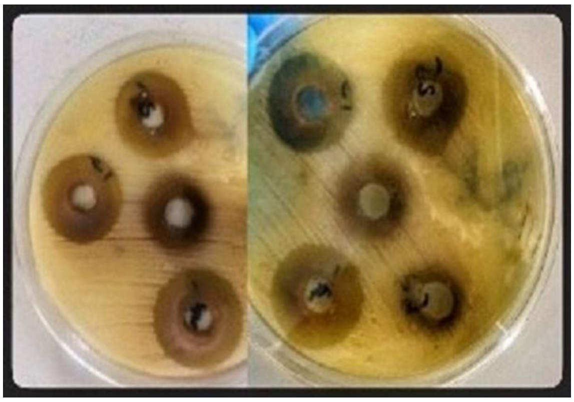


Figure 4: The inhibition zones of the ethanolic extract of *Rosa damascenes'* flower buds.

Part of the flower, which is a modified adjacent plant leaf called the petal, has an inhibitory effect and is a natural antibacterial against many Gram-positive and Gram-negative pathogens [25]. Because it contains active ingredients and secondary metabolites that have an antibacterial effect and is a rich source of natural antioxidants and anti-inflammatory agents [26]. A study of different aqueous and alcoholic extracts conducted by [27] showed that these extracts affect Gram-positive and Gram-negative bacteria. The aqueous and alcoholic extract has an inhibitory effect on the growth of many pathogens, especially antibiotic-resistant bacteria, including *Staphylococcus aureus* and *Staphylococcus* *epidermidis*, which are methicillin-resistant and did not show any effect on *Escherichia coli* bacteria [28]. R. damascene is an ornamental plant and the flower is the important part that contains fragrant essential oils.

Many pharmacological properties have been reported, as it is considered an important antibacterial agent, an anti-HIV agent, and a cough suppressant. The ethanolic extract exhibits strong antibacterial and antifungal activity against a wide range of microorganisms and shows superior inhibitory effectiveness compared to the aqueous extract. No toxic effects of the ethanolic extract of *Rosa damascene* on living cells or hemolysis were observed when tested against human blood cells.



(a) (b)

Figure 5: The effect of the plant extract from the flower buds of *Rosa damascenes'*: a) shows the effect of the aqueous extract on Pseudomonas aeruginosa, while b) represents the effect of the ethanolic extract.

Studies have shown that the essential oils in *Rosa damascenes* can reduce pain and anxiety resulting from the dressing and cleaning of burns through the use of aromatherapy. Burns caused by various bacteria are a major cause of disability and death worldwide. Burns can be accompanied by physical, psychological, physiological changes or serious illnesses, with pain, redness and inflammation being the main side effects. It can also lead to mental and psychological illnesses such as depression and other psychological problems[29]. In addition, the essential oils found in Rosa damascene can improve sleep quality. A study has shown that it reduces anxiety and improves sleep quality, especially in patients in the cardiac care unit [30]. The pharmacological, inhibitory, antidepressant and anti-inflammatory properties of Rosa damascene are due to the presence of a group of phenolic compounds [31].

Studies have shown that plants are a vital source of a variety of secondary metabolites, which are used in the use and manufacture of different types of medicines. Medicinal plants in particular play a vital role in the health of the ecosystem in general and humans and society in particular, which necessitates the study, knowledge and identification of many of the compounds produced by these plants and the study of their composition to facilitate their use in the pharmaceutical industry. Among these main secondary compounds are phenols, alkaloids and terpenes. Medicinal plants containing alkaloids have been used for a long time, as the first alkaloids were isolated in the nineteenth century. Their medical and pharmaceutical uses were studied directly and their uses are still in various pharmaceutical applications. As for terpenoids, which are also used in medical fields, they are found in every natural diet [32]. In ancient times, plants were used to treat many diseases that affect humans.

All worlds, especially the plant kingdom, are valuable because they contain many compounds that play an important role in the pharmaceutical industry. In addition, natural products are less harmful than manufactured chemical products. Plants contain phenolic compounds that are important for human health and are used to prevent many diseases. These compounds are important because of their antioxidant, anti-inflammatory, antibacterial and anticancer effects, and they have protective effects on the heart and enhance immunity [32], [33]

4 CONCLUSIONS

The findings of this study demonstrate that Rosa damascena flower bud extracts—particularly the ethanolic and aqueous formulations—exhibit considerable broad-spectrum antibacterial activity against several clinically significant Gram-positive and Gram-negative bacterial isolates. The ethanolic extract, in particular, showed pronounced inhibitory effects against Staphylococcus aureus, Serratia, and Pseudomonas aeruginosa, indicating its potential as an effective alternative to conventional antibiotics, especially in treating drug-resistant infections. The aqueous extract also displayed significant activity against Klebsiella pneumoniae and Proteus spp., suggesting that different solvent systems may extract distinct active compounds with varying antimicrobial targets. The Rosa damascene plant, especially the aqueous and alcoholic extract of the flower buds of the plant, has an inhibitory effect against Gram-negative and Gram-positive bacteria.

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