Synergistic effect of a mixture of Frankenia Florida (L chevall) plant extract with some antibiotics against some pathogenic bacterial species

Zeccar Abdellah[1]*, Djari Loubna[1], Atmani Abdelaali[2], Hadef Derraji[1], Belfar Mohamed Lakhdar[1]

[1]VPRS Laboratory, Faculty of Mathematics & Matter Sciences University of Kasdi Merbah, B.P. 511, 30000, Ouargla, Algeria
[2]Ibn Khaldoun University Tiaret,
**E-mail: zeccar76@gmail.com*

Received :21/02/2026 | **Accepted**: 11/06/2026 | **Published:** 01/09/2026

Abstract

The purpose of this study is to investigate and evaluate the antibacterial activities of Frankenia Florida (L chevall) extracts (ethanol/water) against four strains of bacteria: Escherichia coli (ATCC 25922), Staphylococcus aureus(ATTC 25923) Bacillus Cereus and Condida Albicans using the diffusion method. The results revealed that all extracts have a certain biological activity against gram-negative and Gram-positive bacteria at 1000 and 5000 g/ml. In addition, the extracts (ethanol/water) showed the highest activity, is against Pseudomonas aeruginosa. The combination of Frankenia Florida (L chevall) with each of the standard antibiotics: Co-trimoxazole (COT 25µg), Metromidazole (MT5µg), Amikacin (AK30µg) Amoxicillin (AMX 25µg), Cefazoline (CZ 30µg). They were more active and showed significant synergistic effects, extracts (ethanol/water) of medicinal plants Frankenia Florida (L chevall), It also showed strong synergistic effects. The results of this study suggest that Frankenia Florida (L chevall) be used to treat diseases caused by the organisms studied. Further, pharmacological and chemical studies can be carried out in order to isolate and identify the chemical constituents responsible for antimicrobial activity in selected plants.

Keywords: Frankenia Florida (L chevall), medicinal plant, biological study, extract, antibiotic.

1. Introduction

Most bacterial infections are treated with antibiotics, but at present time the natural herbal treatments (folk medicine) has spread dramatically and sometimes without resorting to drugs and synthetic materials. However, due to the appearance of new strains of the bacteria and the weakness of chemotherapeutics and antibiotic resistance exhibited by pathogens has led to the screening of several medicinal plants for their potential antimicrobial activity [1-2]. An increasing number of reports dealing with the assessment of antimicrobial effects of different extracts of various medicinal plants are frequently available [3].

In this study, we are trying to measure the biological activity of rosemary and mixing it with some antibiotics.

2. Frankenia Florida (L chevall)

The genus Frankenia almost alone represents the entire Frankeniaceae family. This genus includes about seventy species, twelve of which are found in North Africa, including five in the Sahara [4].

These are generally plants of saline soils [5]. The genus Frankenia is composed of herbaceous perennials or subshrubs with opposite leaves without stipules and fused at the base, often ericoid, with leafy buds in their axils. They constitute pink or purplish flowers containing calyxes of 4 to 5 fused pieces, a corolla of 4 to 5 free pieces, petals of ligulate length and 4 to 5 stamens. The ovary is generally superior and the unilocular has numerous seeds of elongated style. The fruit is a capsule included in the calyx [6]. These are common plants of the salty terrains of the High Plateaus and the northern Sahara [7]. Due to their extreme variability, determining species is always difficult.

Literature studies conducted on species of this genus have shown that only three species are reported as medicinal plants in the literature, including *F. pulverulenta* used in Saudi Arabia for its analgesic and carminative properties [8] and in Tunisia for its antiviral properties against the herpes virus (Herpes simplex type 1) [9]. and its neuroprotective properties in PC 12 cells [10]. In South America, Frankenia triandra is used in folk medicine as an antiseptic agent. According to an ethnobotanical study of medicinal plants used in Morocco, the leaves of F. corymbosa are used in the treatment of cystitis in women. On the other hand, in Algeria, species of this genus have very limited exploitation in traditional medicine.

3. Materials and methods

Fresh Frankenia Florida (L chevall) plants were collected from the Hamraya region, north of Oued Souf, Algeria. The sample was deposited in the scientific research laboratory, Faculty of Materials Sciences, Ibn Khaldoun University, Tiaret, Algeria. The fresh plant was washed under running tap water, air-dried in the dark, then homogenized into a fine powder and stored in a tightly sealed container away from light and moisture.

3-1.Plant sample extraction:

100 g of the leaf powder of the plant *frankenia florida L chevall* was soaked in petroleum chloroform for 24 hours in order to get rid of fats and chlorophyll. After chloroform was removed from the filtration process after drying, the plant powder was soaked in a mixture (methanol / water) (90 - 10) % and left for 24 hours with occasional stirring, then filtered again, the ball is repeated 3 times in a row until all the active ingredient is exhausted, then the resulting solution is concentrated and dried in a rotary evaporator under low pressure.

3-2.Microorganisms All bacterial standard strains:

Escherichia coli (ATCC25922), Staphylocoque aureus (TTC 25293) , Bacillus Cereus ATCC 11778) and Condida albicans were obtained and diagnosed in the Microbiology Laboratory, Tiaret Hospital, Algeria.

3-3.Preparation of the bacterial culture media:

3.7 g of Muller Hilton agar were mixed with hot distilled water and autoclaved at 121°C and 02 atm for 15 min. After autoclaving, it was allowed to cool to 45°C in a water bath. Then the medium was poured into sterilized petri dishes with a uniform depth of approximately 05 mm [11].

3-4.Preparation of plant extract impregnated discs:

Whatman N°01 filter paper was used to prepare discs of 06 mm in diameter. They were sterilized by autoclaving and then dried during the autoclaving cycle. The discs were then impregnated with extract of the plants [12].

3-5.Disc diffusion method:

Disk propagation method:

The disc diffusion method for antimicrobial susceptibility testing was performed according to the standard method by Kirby-Bauer to evaluate the presence of antibacterial activities of the plant extract. A bacterial suspension adjusted to 0.5 McFarland standard (1.5 x 108 CFU/ml) was used to evenly inoculate Mueller Hinton agar plates using a sterile swab[13]. Discs impregnated with the plant extract were placed individually on the surface of Mueller-Hinton agar. The discs were spaced far enough apart to avoid reflection waves from the edges of the Petri dishes and overlapping damping rings. The plate was then incubated at 37°C for 18 h in an upside-down position to look for zones of inhibition. The zones of contraindications produced by susceptible organisms are defined by a circular area of clearing around the discs impregnated with the plant extract. The diameter of the zone of inhibition through the center of the disc was measured to the nearest millimeter.

The resulting residue of the extract stored at 04°C was tested at a concentration of 10–03 g/mL and prepared in DMSO[14].

Figure 1: Fresh *Frankenia Florida (L chevall*),, picked from the Hamraya area north of Wadi Souf,Algeria.

igure 2: Extract (ethanol/water) of *Frankenia Florida (L chevall)*

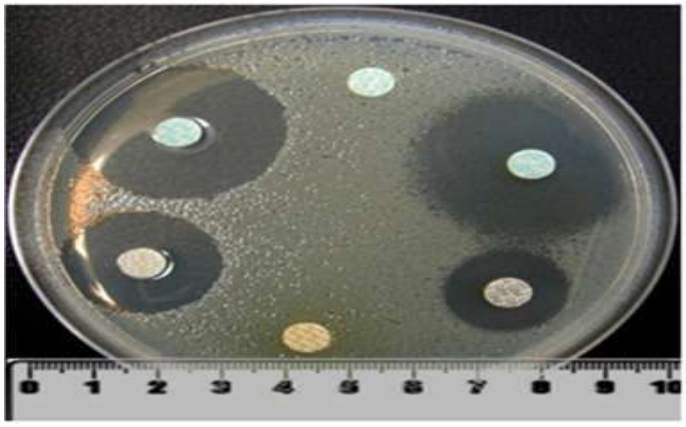

Figure 3: Measurement of the diameter of the inhibition zone in mm

Table 1:Comparison of rates of inhibition of rosemary plants and their mixtures with antibiotics (in mm) against bacteria.

Diameter of inhibition zone (mm)				
Bacteria Strains Plant extracts	*Escherichia coli (ATTC 25922)*	*Staphylococcus aureus (ATTC 25923)*	*Bacillus Cereus*	*Condida Albicans*
Frankenia Florida (R_1)	12	10	08	11
COT $_{25\mu g}$ (R_2)	32	32	20	35
frankenia /COT $_{25\mu g}$ R_3	37	25	19	37
$\Delta R_1 = R_3 - R$ (1 ou 2)	+25	-07	-01	+02
AK $_{30\mu g}$ R_4	30	22	30	33
frankenia /AK $_{30\mu g}$ R_5	29	26	22	30
$\Delta R_2 = R_5 - R$ (1 ou 4)	-01	+02	-08	-03
CZ $_{30\mu g}$ R_6	16	36	10	31
frankenia /CZ $_{30\mu g}$ R_7	20	-	-	31
$\Delta R_3 = R_7 - R$ (1 ou 6)	+04	-36	-10	00
MT $_{5\mu g}$ R_8	9	-	-	11
frankenia / MT$_{5\mu g}$ R_9	-	**-**	**10**	12
$\Delta R_4 = R_9 - R$ (1 ou 8)	-09	**00**	**+02**	+01
AMX $_{25\mu g}$ R_{10}	11	30	08	30

frankenia / AMX $_{25\mu g}$ R_{11}	18	**-**	**-**	30
Δ R $_5$ = R_{11} - R (1ou 10)	+07	**-30**	**-08**	00

4. Results

The studied isolates also showed their sensitivity to the combination of extract of (*Frankenia /AK 30µg*) at rates between 22-30 mm, as for the mixture of extract of (*Frankenia /CZ30µg*) at rates between 20-31 mm, and the mixture of extract of (*Frankenia /MT 5µg*) at rates between 10-12 mm, while the mixture of extract of (*Frankenia /AMX25µg*) at rates between 18 and 30 mm. To know the effectiveness of the combination of *Frankenia Florida* extract (*L chevall*) with antibiotics, we compare the inhibition diameter of the *Frankenia Florida* extract and the inhibition diameter of the antibiotic with the inhibition diameter of the mixture of *Frankenia Florida* extract / antibiotic, where we subtract the extract which has a greater inhibition diameter than the inhibition diameter of the mixture to see the effectiveness of the mixture, for example, with Escherichia coli the damping diameter of the *Frankenia Florida* extract was 12 mm while the damping diameter of the antagonist COT 25µg was 32 mm, while the damping diameter of the *Frankenia Florida* extract / *COT25µg* was 37 mm, so we subtract the largest damping diameter which is the *Frankenia Florida* from the damping diameter of the mixture as:

Δ R = R (mixture) – R (mixture or extract).

Δ R = 37- 32 = +25.

Note that the damping diameter of the mixture increases by 25 mm compared to the damping diameter of the *Frankenia Florida* extract.

5. Discussion

shows a comparison of the rates of antibiotic inhibition diameters with the mixture of *Frankenia Florida (L chevall)* plant leaf extract and antibiotics in mm against bacteria, as the comparison showed that all the isolates studied are sensitive to the mixtures at different rates, some of the mixtures were raised to the required level and others not, so some antibiotics vitality inhibited the action of the active ingredients of *Frankenia Florida (L chevall)* extract and some of the elements of *Frankenia Florida (L chevall)* extract decreased the effectiveness of the antibiotic in the mixture.

In the mixture *(Frankenia Florida/ (COT),* it was more effective than *Frankenia Florida* extract and antibiotic *(COT)* on *Escherichia coli, Condida Albicans*, while the combination of (*Frankenia Florida extract / AK)* was more effective than *Frankenia Florida* extract and (*AK*) antibiotic on *Staphylococcus aureus* bacteria, the combination of *Frankenia Florida extract / (CZ)* was more effective than *Frankenia Florida* extract and antibiotic *(CZ*) on *Escherichia coli*, while the combination of (*Frankenia Florida* extract / *MT*) was more effective than *Frankenia Florida* extract and antibiotic (*MT*) on Bacillus, and Condida albicans, while the combination of

Frankenia Florida extract / *(AMX*) was more effective than *Frankenia Florida* extract and antibiotic (*AMX*) on *Escherichia coli.*

6. Conclusion

With this work, we were able to study the *Frankenia Florida (L chevall)* plant and compare the antibacterial activity and synergistic effect of the *Frankenia Florida* (*L chevall*) plant leaf extract with some antibiotics as well as with the extract (methanol/water) against four bacterial isolates. We found that the extract (methanol/water) of the plant has a great effect on epidemiological bacterial groups, such *as Escherichia coli*, which are considered the main cause of infection in hospitals, which means that this plant extract can be used to inhibit or suppress the spread of bacteria to ensure health protection. Finally, we hope to have succeeded in achieving the desired goal, which is to study the antibacterial activity and synergistic effect of an important plant in our folk medicine. or at least we have raised questions about an important aspect of pharmacy in the present era, so that we and others can scrutinize further to enrich the balance of scientific research in Algeria.

7. Acknowledgment

We thank Professor Dr. Al-Hadef Al-Daraji and Professor Othmani Abdelali for the advice and assistance provided. I also do not forget to extend my thanks to all the employees of the Delmaji Hospital in Tiaret.

8. References

1. Benkeblia N, Antimicrobial activity of essential oil extracts of various onions (allium cepa) and garlic (Allium stivum). Lebensm-Wiss u-Technol2004 ; 37: 263-267.
2. Jean-Claude Rameau et al., French forest flora: Mediterranean region, 2008.
3. Preliminary phytochemical analysis and a comparative study of the antibacterial activity of Cyndondactylon (L) Pers roots.Research Journal of Pharmaceutical, Biological and Chemical Sciences,March–April 2016.
4. Govaerts, R., 2001. Frankenia L. Plants of the World Online. Kew Science. Plants World Online. URL http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:16452-1 (Date de consultation :12/07/2018).
5. Quezel, P., Santa, S., 1962-1963. Nouvelle flore de l'Algérie et des régions désertiques méridionales, Vol:1 -2, Éditions du centre national de la recherche scientifique. Paris.

6. Ozenda, P., 2004. Flore et végétation du Sahara. Éditions du centre national de la recherche scientifique, Paris.

7. Megdiche Ksouri, W., Chaouachi, F., M'Rabet, R., Medini, F., Zaouali, Y., Trabelsi, N., Ksouri, R., Noumi, E., Chedly, A., 2011. Antioxidant and antimicrobial properties of Frankenia thymifolia Desf. fractions and their related biomolecules identification by gas chromatography/ mass spectrometry (GC/MS) and high performance liquid chromatography (HPLC). J Med Plants Res. 5, 5754–5765.
8. Youssef, R.S.A., 2013. Medicinal and non-medicinal uses of some plants found in the middle region of Saudi Arabia. J Med Plants Res. 7, 2501 –2517. https://doi.org/10.5897/JMPR12.798
9. Ben Sassi, A., Harzallah-Skhiri, F., Bourgougnon, N., Aouni, M., 2008. Antiviral activity of some Tunisian medicinal plants against Herpes simplex virus type 1. Nat Prod Res. 22, 53–65. https://doi.org/10.1080/14786410701589790
10. Ben Mansour, R., Megdiche-Ksouri, W., Cluzet, S., Krisa, S., Richard, T., Ksouri, R., 2016. Assessment of antioxidant activity and neuroprotective capacity on PC12 cell line of Frankenia thymifolia and related phenolic LC-MS/MS Identification. Evid Based Complement Alternat Med.
11. Cappuccino JG, Sherman N. Micro-A Laboratory manual. Addison Wesley Longman Inc 1999; 254-256.
12. Swarnamoni D, Mukundam B, Shagufa A. Asian PharmClin Res 2013; 6 (4) : 136-139.
13. Atmani A, Sekhri L. A Comparative Study of the Antibacterial Activity of Cyndon Dactylon (L) Pers ; its Synergic Effect With Some of the Standard Antimicrobs and Extracts of Some Medicinal Plants. Biomed Pharmacol J 2016;9(1)
14. Bensaci H, Sekhri L. A comparative study of the antibacterial activity of aristida pungens desfleaves; its synergic effect with some of standard antimicrobs International Journal of Current Researchpp.39672-39680, October, 2016.