THE NEW ARMENIAN MEDICAL JOURNAL
Volume18 (2024), Issue 3, p.99-105

DOI: https://doi.org/10.56936/18290825-3.v18.2024-99

COMBATING MULTI-DRUG RESISTANCE: POTENTIALS OF KALANCHOE PINNATA EXTRACTS AGAINST BACTERIAL PATHOGENS

Poyil M.M.[1]*, Shamna K.P.[2], Raja K.[3]

[1] Department of Basic Medical Sciences, College of Medicine, Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia
[2] Deseeya Ayurvedic Pharmaceuticals Ltd, Calicut, Kerala, India
[3] Genolites Research and Development Laboratory, Coimbatore, Tamil Nadu, India

Received 12.05023; Accepted for printing 04.08.2024

Abstract

Background: The rapid rise of microbial resistance to traditional antibiotics has caused grave concerns for the treatment of infectious diseases. This serious problem increases the demand for significant plant-based antibacterial and antimicrobial drugs. Kalanchoe pinnata is one of the plants that has had significant antibacterial effects due to the presence of a wide range of bioactive compounds, so it could be an effective substitute for the current synthetic antibiotics.

The study aimed to evaluate the anti-bacterial and antioxidant properties of a methanolic extract of Kalanchoe pinnata leaves.

Materials and Methods: The preliminary phytochemical screening was performed using standard biochemical assays. The anti-bacterial activity was determined against multidrug-resistant E. coli and S. aureus using the well-diffusion method. The 2,2-diphenyl-1-picrylhydrazyl and ferric ion reducing antioxidant potential assays were used to evaluate the antioxidant activity.

Results: The methanolic extract of Kalanchoe pinnata leaves showed the presence of flavonoids, saponins, steroids, phenol, quinones, and proteins. The remarkable anti-bacterial activities were displayed against multidrug-resistant E. coli and S. aureus, with minimum inhibitory concentration values of 50 mg/mL and 12.5 mg/mL, respectively. The significant antioxidant activity was exhibited in 2,2-diphenyl-1-picrylhydrazyl and ferric ion reducing antioxidant potential assays.

Conclusion: The results of this investigation suggested that the Kalanchoe pinnata extract may be useful as an alternative for antibiotics and may have pharmacological promise in the treatment of many diseases.

Keywords: *anti-bacterial, antibiotics, antioxidant, E. coli, S. aureus, Kalanchoe pinnata, multidrug resistance.*

Introduction

Infectious diseases are regarded as a serious concern for global health, and their consequences are on the increase throughout the globe, owing mostly to drug resistance to pathogenic bacteria, which has been widely documented across the world [*Sahin A et al., 2019*]. It is a major issue when harmful bacteria become resistant to specific drugs, and the rise of multidrug-resistant strains

Cite This Article as:

Poyil M.M., Shamna K. P., Raja K. (2024). Combating multi-drug resistance: potentials of kalanchoe pinnata extracts against bacterial pathogens: A systematic review, The New Armenian Medical Journal, vol.18(2), 99-105; https://doi.org/ 10.56936/18290825-3.v18.2024-99

Address for Correspondence:

Muhammad Musthafa Poyil, M.Phil., Ph.D, Lecturer & Lab. Safety In-charge,
Department of Basic Medical Sciences, College of Medicine Prince Sattam bin Abdulaziz University
Al-Kharj 11942, Saudi Arabia
Tel.: +966565634412 (mob.), +966 15886 176
E-mail: m.poyil@psau.edu.sa

constitute a growing challenge in the management of bacterial infections [*Chattopadhyay D, 2010*].

In recent times, there have been increases in antibiotic-resistant strains of clinically important pathogens, which have led to the emergence of new bacterial strains that are multi-resistant [*Pattewar S et al., 2013*]. The search for novel antimicrobial agents to combat resistance has always been a primary research focus for the pharmaceutical sector [*Abreu A et al., 2012*]. The discovery and development of novel active compounds capable of partially or totally inhibiting the resistance mechanisms of bacteria is a significant prospective approach to addressing the resistance issue [*Walker E, Levy F, 2001*].

Numerous studies focused on developing novel alternative pharmaceuticals to alleviate resistance issues. Scientists have been interested in phytochemicals from plants for a long time because of their variety in structure, lack of negative side effects, and higher level of public acceptance [*Geddawy A et al., 2023; Ferrazzano G et al., 2015*]. Traditional medicines are a vital component in healthcare sectors all over the world. Plants and plant extracts are used as a primary source of healthcare for around three-quarters of the worldwide population. The medicinal plants are regarded as a sustainable and appealing source of antimicrobial compounds, with several in vitro studies proving the pharmacological activities of phytoconstituents as an alternative source for antibiotics [*Abreu A et al., 2012*]. The majority of therapeutically useful compounds derived from plants are secondary plant metabolites. Depending on the species, the geography, and the climate of the nation of origin, they have a broad spectrum of activities and may possess various types of bioactive components [*Savoia D, 2012*].

Kalanchoe is a genus with numerous species, the majority of which are employed as medicinal agents to cure a variety of health conditions [*Rajsekhar P et al., 2016*]. The bufadienolides found in the leaves are a class of extremely potent compounds that have attracted the attention of researchers [*Quazi M et al., 2011*].

Kalanchoe pinnata is traditionally used to treat diarrhoea, chlamydia, cithiasis, earaches, rheumatism, burns, inflammation, ulcers, abscesses, insect bites, and whitlow [*Biswas S et al., 2011*]. *Kalanchoe pinnata* is one of the plants reported to have beneficial antibacterial properties. Hence, this plant is a viable alternative to the present synthetic antibiotics since it contains bioactive components that suggest its antibacterial activity against pathogenic microbes and has a number of therapeutic effects [*Tajudin N, Ismail N, 2022*]. The current study is to evaluate the anti-bacterial and antioxidant properties of methanolic extract of *Kalanchoe pinnata* leaves.

Materials and methods

Sample collection: The leaves of *Kalanchoe pinnata* were collected from nearby nursery. The collected leaves were washed thoroughly using sterile distilled water, and they were shade dried at room temperature. The dried leaves were finely pulverised and stored in sealed containers.

Extract preparation: 20 *g* of powdered *Kalanchoe pinnata* leaves were inserted in a porous bag in the Soxhlet apparatus. A 200 *mL* methanol solution was added to the extractor, which was then heated to 60°C and left for six hours for the optimum extraction of phytoconstituents. The solvent was evaporated, and the obtained extract was stored for further analysis [*Mohamad C et al., 2023*].

Phytochemical screening: The preliminary phytochemical screening was performed to detect the existence of phytochemicals such as tannins, flavonoids, saponins, steroids, terpenoids, glycosides, phenols, alkaloids, quinones, and proteins using the methods described in the previous works [*Jyothiprabha V, Venkatachalam P, 2016; Boggula N, Peddapalli H, 2017*].

Anti-bacterial activity: Bacterial strains: Two different multi-drug-resistant bacterial strains, such as multidrug-resistant *E. coli* and *S. aureus*, were used to analyse the anti-bacterial activity of a methanolic extract of *Kalanchoe pinnata* leaves.

Antibiotic Sensitivity Test - Disc diffusion method: The Mueller-Hinton medium was sterilised and poured into the sterile petri dishes. The overnight-grown cultures of test bacteria such as multidrug-resistant *E. coli* and *S. aureus* were inoculated into the agar plates, respectively. The standard antibiotic discs like cefmetazole, ciprofloxacin, streptomycin, ampicillin, and tetracycline are placed on an agar surface seeded with test bacterial strains. Then, the plates were incubated overnight and checked for an inhibitory zone

around each disc [*Boggula N et al., 2017*].

Anti-bacterial activity - Well-diffusion method: The anti-bacterial activity of the methanolic extract of *Kalanchoe pinnata* leaves was assessed using the well diffusion method against multidrug-resistant *E. coli* and *S. aureus*. 0.1% of overnight cultures of test organisms were swabbed throughout the Mueller –Hinton agar surface with a sterile cotton swab. Different concentrations of methanolic extract of *Kalanchoe* pinnata leaf extract such as 0.125 *g*, 0.25 *g*, 0.5 *g*, and 1 *g* were introduced to the wells, respectively and the plates were incubated overnight at 37ºC. The diameter of the resulting zone around the well was measured and recorded in millimetres [*Boggula N et al., 2017*].

Minimum Inhibitory Concentration: The resazurin method was used to evaluate the minimum inhibitory concentration of the methanolic extract of *Kalanchoe pinnata* leaves against multidrug-resistant *E. coli* and *S. aureus*, respectively. A sterile 96 well microtiter plate was added along with 100 µl of methanolic extract of *Kalanchoe pinnata* leaves, and 50 µl of nutritional broth was pipetted into each of the remaining wells. Each well contained 50 µ*l* of the test material, which was diluted in successive steps to ever-lower quantities. Following the addition of 10 µl of Resazurin to each well, the appropriate test organisms [5 $X10^6$ *cfu/mL*] were then added.

The minimum bactericidal concentration value was determined when there was no growth or development of the bacterial colony from the directly plated contents of the microtiter plate wells [*Sarker S et al., 2007; Elshikh M et al., 2016*].

Antioxidant activity: The antioxidant activity of the methanolic extract of *Kalanchoe pinnata* leaves was determined using 2,2-di-phenyl-1-picrylhydrazyl (DPPH) radical scavenging and the ferric ion reducing antioxidant potential (FRAP) assay. Ascorbic acid was used as a standard.

DPPH radical scavenging assay: Methanolic extracts of *Kalanchoe pinnata* leaves at various concentrations [25, 50, 75, 100, 250, 500, 750, and 1000 µg/*mL*] were each combined with 3 *mL* of a 0.1 *mM* methanolic DPPH solution and incubated at room temperature for 30 *min*. The optical density was assessed using a UV-Vis spectrophotometer at λ = 571 *nm*. Inhibition was estimated bythe following formula:

$$\text{Inhibition (\%)} = \frac{\text{AC-AS}}{\text{AS}} \times 100$$

where AC is Absorbance of Control, AS - Absorbance of Sample.

FRAP assay: The FRAP reagent solution, which consists of 10 *mM* TPTZ, 20 *mM* $FeCl_3.6H_2O$, and 300 *mM* sodium acetate buffer in a 10:1:1 ratio, was made and kept at 37°C. The various aliquots of methanolic extract of *Kalanchoe pinnata* leaves were mixed with 3 *mL* of FRAP reagent solution. The test tubes with the reaction mixture were incubated at 37°C for 30 *min*, and the absorbance was determined at a wavelength of 610 *nm*.

Results

Phytochemical screening: The methanolic extract of *Kalanchoe pinnata* leaves showed the presence of flavonoids, saponins, steroids, phenol, quinones, and proteins. The phytochemicals such as tannins, terpenoids, glycosides, and alkaloids were absent in the *Kalanchoe pinnata* extract. The results of preliminary phytochemical screening were given in table 1.

Antibiotic sensitivity test: The tested bacteria, such as multidrug-resistant *E. coli* and *S. aureus*, were resistant to standard antibiotics like streptomycin, cefmetazole, ciprofloxacin, ampicillin, and tetracycline. No inhibitory zone was observed for multidrug-resistant *S. aureus* around any of the antibiotic discs. The growth of multidrug-resistant *E. coli* was slightly inhibited by the streptomycin with zone of inhibition 4 *mm* (Fig. 1).

Table 1.

Phytochemical screening of Methanolic extract of *Kalanchoe pinnata* leaves

Phytochemicals	*K. pinnata* extract
Tannin	-
Flavonoids	+
Saponin	+
Steroid	+
Terpenoid	-
Glycoside	-
Phenol	+
Alkaloid	-
Quinone	+
Protein	+

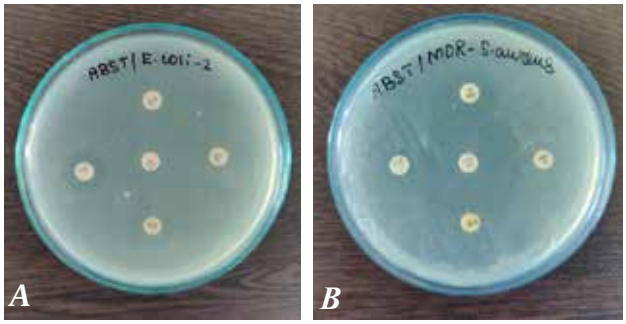

FIGURE 1. *Antibiotic sensitivity test for the bacterial pathogens E. coli (A) and S. aureus (B).*

Anti-bacterial activity: All the tested concentrations of methanolic extract of *Kalanchoe pinnata* leaves exhibited antibacterial activity against the multidrug-resistant *E. coli* as well as the multidrug-resistant *S. aureus*. The maximum inhibitory zone obtained for multidrug-resistant *E. coli* was 19 *mm* and 17 *mm* for *S. aureus*. The minimum inhibitory zones observed for multidrug-resistant *E. coli* and *S. aureus* were 9 *mm* and 8 *mm*, respectively, at 0.125 *g* of extract. The multidrug-resistant *E. coli* was found to be more susceptible to the methanolic extract of *Kalanchoe pinnata* than the multidrug-resistant *S. aureus*. The anti-bacterial activity of the *Kalanchoe pinnata* extract was increased with increasing concentrations of the extract (Fig. 2).

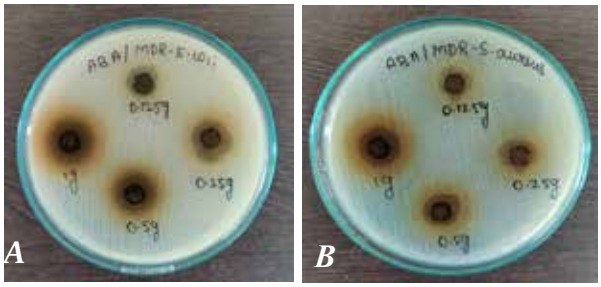

FIGURE 2. *Anti-bacterial activity of methanolic extract of Kalanchoe pinnata for the E. coli (A) and S. aureus (B).*

Minimum inhibitory concentration and minimum bactericidal concentration: The minimum inhibitory concentration value of a methanolic extract of *Kalanchoe pinnata* was determined to be 50 *mg/mL* and 12.5 *mg/mL* for multidrug-resistant *E. coli* and *S. aureus*, respectively (Fig. 3). The minimum inhibitory concentration of the methanolic extract of *Kalanchoe pinnata* plated on the agar plates didn't show any inhibitory zone. Hence, the minimum bactericidal concentration value was also the same as the minimum inhibitory concentration (Fig. 4).

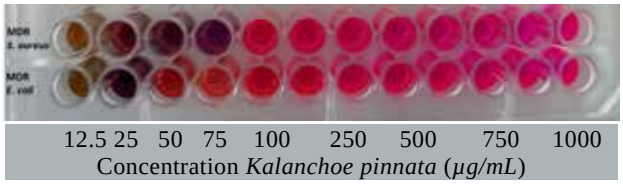

FIGURE 3. *Minimum Inhibitory Concentration of the extract of Kalanchoe pinnata– Resazurin method*

FIGURE 4. *Minimum Bactericidal Concentration of the extract of Kalanchoe pinnata for the E. coli and S. aureus*

ANTIOXIDANT ACTIVITY

DPPH radical scavenging assay: The absorbance shift caused by lowered DPPH was utilised to assess the potential of plant extracts to serve as antioxidants against free radicals. The methanolic extract of *Kalanchoe pinnata* scavenged the DPPH radicals in a concentration-related manner. The highest percentage of inhibition recorded was 73.98 at a concentration of 1000 µg/*mL*. The minimum DPPH scavenging percentage was 1.43 at 25 µg/*mL*. The IC_{50} was found to be 154.52 µg/m.

FRAP assay: The maximum FRAP value obtained at 1000 µg/*mL* was 71.62, whereas the minimum value was observed to be 16.01 at 25 µg/*mL*. The IC_{50} value was calculated to be 127 µg/*mL*.

DISCUSSION

Plants are now being looked at as potential sources of powerful antibacterial agents [*Ojo O et al., 2007*]. *Kalanchoe* sp. have ethnopharmacological uses everywhere they are found and are sometimes referred to as "wonder leaves" due to their usage in healing a variety of diseases. The potent antibacterial capabilities of *Kalanchoe* species have been proven [*Richwagen N et al., 2019*].

The present study investigated the anti-bacterial and antioxidant properties of a methanolic extract of *Kalanchoe pinnata* leaves. Preliminary phytochemical screening carried out using stan-

dard assays showed the presence of flavonoids, alkaloids, saponins, tannins, steroids, and phenols in the ethanolic and aqueous leaf extracts of *Kalanchoe pinnata* [*Hamilton-Amachree A, Uzoekwe N, 2022*]. The methanolic extract (60%) of *Kalanchoe pinnata* leaves exhibited bactericidal action against five out of eight tested bacteria at a concentration of 25 *mg/mL*. *Shigella dysenteriae, Proteus vulgaris, Bacillus subtilis,* and *S. aureus* were shown to be inhibited, while *Klebsiella pneumoniae, P. aeruginosa,* and *Candida albicans* were found to be resistant to the extract [*Akinpelu D, 2000*]. The findings of Biswas et al. (2011) demonstrated the potent anti-bacterial activity of the ethanolic extract of the *Kalanchoe pinnata* leaves against *S. dysenteriae*, *E. coli*, and *P. aeruginosa,* with the zone of inhibition ranging from 6.0 0.35 to 8.2 0.22 *mm*. Interestingly, the growth of pathogenic bacteria such as *Clostridium perfringens, Salmonella typhimurium, Staphylococcus aureus,* and *Enterobacter aerogenes* were inhibited by the methanolic extract of *Kalanchoe pinnata* [*Jassal P et al., 2019*]. The bactericidal potential of the *Kalanchoe mortagei* and *Kalanchoe fedtschenkoi* extracts was evaluated against the *ESKAPE* pathogens [*Richwagen N et al., 2019*]. The study of Sudayasa et al. (2022) disclosed the anti-bacterial activity of different concentrations of ethanolic extract [7.5%, 15%, 30%, 60%, and 100%] of *Kalanchoe pinnata* leaves against *Staphylococcus aureus* and *Salmonella typhi*. The maximum zone of inhibition was recorded for 100% of *Kalanchoe pinnata* leaves against *Staphylococcus aureus* and *Salmonella typhi*, with average inhibitory zone diameters of 22.25 mm and 23 mm, respectively.

The current study showed that the minimum inhibitory concentration values were 50 *mg/mL* and 12.5 mg/mL for multidrug-resistant *E. coli* and *S. aureus*, respectively. Similarly, the minimum inhibitory concentration of an absolute methanol-derived *Kalanchoe pinnata* extract was found to be 10.6 0.53 *mg/mL* and 11.7 0.60 *mg/mL* for *S. aureus* and *E. coli*, respectively, using the Resazurin microtiter-plate assay [*Saleem et al., 2015*]. The findings of Desai P. (2014) revealed that the methanol extract of *Kalanchoe pinnata* leaves inhibited the growth of *E. coli* and *S. aureus* with minimum inhibitory concentration values of 0.35 and 0.7*mg*/100*l* of extract, respectively. However, the methanolic *Kalanchoe pinnata* leaf extract (60%) was tested for antibacterial activity, and the minimum inhibitory concentration and minimum bactericidal concentration values against Staphylococcus aureus were determined to be 30 *mg* [*Pattewar S, Patil D, 2014*], which showed similarities to our findings.

It has been suggested that the phenolic chemicals, especially flavonoids, present in these medicinal plants may be responsible for their antioxidant properties since they include hydroxyl functional groups [*Borkataky M et al., 2014*]. The highest absorption of DPPH (a stable free radical) with a rich purple colour occurs at 517 *nm*. Thus, the methanolic extract of *Kalanchoe pinnata* leaves inhibited the DPPH free radicals in a concentration-related manner. The ethanolic extracts of *Kalanchoe pinnata* showed a concentration-related inhibitory impact in the DPPH assay, where the maximal inhibitory effect was reported to be 49.5% (2000 *g/mL*) [*Cano L et al., 2021*]. The treatment of an alcoholic extract of *Kalanchoe pinnata* leaf extract in a dose-dependent manner successfully scavenged the hydroxyl radicals produced in vitro. The extract dispersed the superoxide radicals generated in the in vitro media in a dose-related manner. The total antioxidant property of *Kalanchoe pinnata* extract was substantial when compared to controls [*Mohan S et al., 2012*]. Similarly, the work done by Jassal et al. (2019) with a methanolic extract of *Kalanchoe pinnata* leaves and stem exhibited concentration-dependent DPPH inhibition.

The ability of plant extracts to convert the Fe^{3+}-TPTZ complex to Fe^{2+} ions in acidic environments is used as a sign of their potential as an antioxidant [*Suksungworn et al., 2021*]. Hence, according to our result, the methanolic extract of *Kalanchoe pinnata* affects the reduction of the Fe^{+3} TPTZ complex to a ferrous ion by acting as an electron donor. Likewise, the hydroalcoholic extract of the *Kalanchoe pinnata* leaves was evaluated using the ferric ion reducing antioxidant potential and Cupric Reducing Antioxidant Capacity assays [*Phatak and Hendre, 2014*].

Conclusion

The methanolic extract of *Kalanchoe pinnata* contains the phytochemicals such as flavonoids, saponins, steroids, phenol, quinone, and protein.

Moreover, it has exhibited bactericidal action against multidrug strains such as multidrug-resistant *E. coli*, and *S. aureus*. The potent antioxidant properties of the *Kalanchoe pinnata* extract was proved by its scavenging activity of 2,2-di-phenyl-1-picrylhydrazyl and ferrous ion reducing power. Hence, the methanolic extract of *Kalanchoe pinnata* have the ability to serve as the antimicrobial agent to combat the multidrug resistance and also aids in the reduction of the reactive oxygen species levels.

Acknowledgments: *The authors are grateful to the Deanship of Scientific Research, Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia for its support and encouragement in conducting the research and publishing this report.*

REFERENCES

1. *Abreu AC, McBain AJ, Simoes M (2012).* Plants as sources of new antimicrobials and resistance-modifying agents. Natural product reports. 29(9): 1007-1021 DOI: 10.1039/c2np20035j
2. *Akinpelu DA (2000).* Antimicrobial activity of Bryophyllum pinnatum leaves. Fitoterapia. 71(2): 193-194 DOI: 10.1016/s0367-326x(99)00135-5
3. *Biswas SK, Chowdhury A, Das J, Karmakar UK, Shill MC (2011).* Assessment of cytotoxicity and antibacterial activities of ethanolic extracts of Kalanchoe pinnata Linn. (Family: Crassulaceae) leaves and stems. International Journal of Pharmaceutical Sciences and Research. 2(10): 2605 DOI: 10.13040/IJPSR.0975-8232.2(10).2605-09
4. *Boggula N, Peddapalli H (2017).* Phytochemical analysis and evaluation of in vitro antioxidant activity of Punica granatum leaves. International Journal of Pharmacognosy and Phytochemical Research. 9(8): 1110-1118 DOI: 10.25258/phyto.v9i08.9618
5. *Boggula N, Reddy SRN, Alla TS, Farhana A, Battineni J, Bakshi V (2017).* Phytochemical evaluation and in vitro anti-bacterial activity of dried seeds of Abrus precatorius. International journal of pharmaceutical sciences review and research. 44(1): 101-107
6. *Borkataky M, Kakoti BB, Saikia LR (2014).* Influence of total phenolic content and total flavonoid content on the DPPH radical scavenging activity of Costus speciosus (Koen Ex. Retz.) Sm. South Asian Journal of Experimental Biology. 4(5): 261-266 DOI: 10.38150/sajeb.4(5).p261-266
7. *Cano LPP, León E, Mero A, Morán-Pinzón J, León EGD, Quintero EJ (2021).* Evaluation of the leaf extracts of Kalanchoe pinnata and Kalanchoe daigremontiana chemistry, anti-oxidant and anti-inflammatory activity. European Journal of Medicinal Plants. 32(5): 45-54 DOI: 10.9734/EJMP/2021/v32i530392
8. *Chattopadhyay D (2010).* Ethnomedicine: a source of complementary therapeutics. Research Signpost, Beliaghata, Kolkata.
9. *Christiana KA, Mary KL, Esther AA (2019).* Phytochemical, antioxidant and antimicrobial evaluation of nigerian Kalanchoe pinnata (LAM.). Journal of Chemical Society of Nigeria. 44(6)
10. *Desai PV (2014).* Phytochemical Analysis and In-Vitro Antibacterial Activity of Kalanchoe pinnata against Human Pathogens Isolated from UTI. International Conference on Multidisciplinary Research & Practice. 1(7): 103-106
11. *Elshikh M, Ahmed S, Funston S, Dunlop P, McGaw M, Marchant R, Banat IM (2016).* Resazurin-based 96-well plate microdilution method for the determination of minimum inhibitory concentration of biosurfactants. Biotechnology letters. 38(6): 1015-1019 DOI: 10.1007/s10529-016-2079-2
12. *Ferrazzano GF, Cantile T, Roberto L, Ingenito A, Catania MR, Roscetto E, Pollio A (2015).* Determination of the in vitro and in vivo antimicrobial activity on salivary Streptococci and Lactobacilli and chemical characterisation of the phenolic content of a Plantago lanceolata infusion. BioMed research international. DOI: 10.1155/2015/286817
13. *Geddawy A, Shamna KP, Poyil MM (2023).* Catheter-associated urinary tract biofilms: can achyranthes aspera extract work against them? The New Armenian Medical Journal. 17(2): 110-117 DOI: 10.56936/18290825-2023.17.2-110
14. *Hamilton-Amachree A, Uzoekwe NM (2022).* Phytochemical analysis and assessment of the antibacterial and antioxidant activities of the

aqueous and ethanolic leaf extracts of life plant (Kalanchoe pinnata l.) in the Niger Delta Nigeria. Faculty of Natural and Applied Sciences Journal of Scientific Innovations. 3(3): 1-10 (Retrieved from: https://www.fnasjournals.com/index.php/FNAS-JSI/article/view/72)

15. *Jassal PS, Joshi R, Sharma M (2019).* Evaluation of Antioxidant, Antibacterial and Phytochemical Properties of Kalanchoe pinnata, Kalanchoe Robusta and Kalanchoe Blossfediana. Think India Journal. 22(16): 611-626
16. *Jyothiprabha V, Venkatachalam P (2016).* Preliminary phytochemical screening of different solvent extracts of selected lndian spices. Int J Curr Microbiol App Sci, 5(2): 116-122 DOI: 10.20546/ijcmas.2016.502.013
17. *Kendeson CA, Kagoro ML, Adelakun EA (2021).* Phytochemical and pharmacological evaluation of Nigerian Kalanchoe pinnata (Lam.) stem-bark. Journal of Chemical Society of Nigeria. 46(4): 0751-0756
18. *Mohamad CWSR, Zaini SZ, Jamaluddin NJ, Kasim KF, Sulaiman SF (2023).* Antimicrobial activity and phytochemical analysis of Azadirachta Indica (neem) and Clinacanthus Nutans (snake grass) leaves extract. In AIP Conference Proceedings. AIP Publishing LLC. 2562(1): p070002 DOI: 10.1063/5.0115900
19. *Mohan SC, Balamurugan V, Elayaraja R, Prabakaran AS (2012).* Antioxidant and phytochemical potential of medicinal plant Kalanchoe pinnata. International journal of pharmaceutical sciences and Research. 3(3): 881
20. *Ojo OO, Ajayi AO, Anibijuwon II (2007).* Antibacterial potency of methanol extracts of lower plants. Journal of Zhejiang University. Science. B. 8(3): 189-191 DOI: 10.1631/jzus.2007.B0189
21. *Pattewar SV, Patil DN, Dahikar SB (2013).* Antimicrobial potential of extract from leaves of Kalanchoe pinnata. International Journal of Pharmaceutical Sciences and Research. 4(12): 4577 DOI: 10.13040/IJPSR
22. *Pattewar SV, Patil DN (2014).* Formulation of herbal antibacterial cream by using extract from Kalanchoe pinnata leaves. Research Journal of Topical and Cosmetic Sciences: 5(1): 1-4
23. *Quazi MA, Tatiya AU, Khurshid M, Nazim S, Siraj S (2011).* The miracle plant (Kalanchoe pinnata): a phytochemical and pharmacological review. Int J Res Ayurveda Pharm. 2(5): 1478-1482
24. *Rajsekhar PB, Bharani RA, Ramachandran M, Angel KJ, Rajsekhar SP (2016).* The "wonder plant" Kalanchoe pinnata (linn.) pers.: A review. Journal of Applied Pharmaceutical Science. 6(3): 151-158 DOI: 10.37191/Mapsci-2582-4937-4(2)-029
25. *Richwagen N, Lyles JT, Dale BL, Quave CL (2019).* Antibacterial activity of Kalanchoe mortagei and K. fedtschenkoi against ESKAPE pathogens. Frontiers in pharmacology. 10: 67 DOI: 10.3389/fphar.2019.00067
26. *Sahin AZ, Mou MA, Pervin A, Karim M, Tajwar A, Asim MH (2019).* Antimicrobial activity of natural compounds from Kalanchoe crenata against pathogenic bacteria. Clin Microbiol Infect. 4: 1-4 DOI: 10.15761/CMID.1000162
27. *Sarker SD, Nahar L Kumarasamy Y (2007).* Microtitre plate-based antibacterial assay incorporating resazurin as an indicator of cell growth, and its application in the in vitro antibacterial screening of phytochemicals. Methods. 42(4): 321-324 DOI: 10.1016/j.ymeth.2007.01.006
28. *Savoia D (2012).* Plant-derived antimicrobial compounds: alternatives to antibiotics. Future microbiology. 7(8): 979-990 DOI: 10.2217/fmb.12.68
29. *Sudayasa IP, Dewi GAK, Ariasnitra S, Purnamasari Y (2022).* Antibacterial test of ethanol extract of "Cocor-Bebek" leaves (Kalanchoe pinnata) against the growth of Staphylococcus aureus and Salmonella typhi. GSC Biological and Pharmaceutical Sciences. 19(3): 204-212 DOI: 10.30574/gscbps.2022.19.3.0226
30. *Tajudin NJ, Ismail INA (2022).* Antimicrobial Activity of Kalanchoe pinnata: A review. Malaysian Journal of Science Health & Technology. 8(1): 31-37 DOI: 10.33102/2022245
31. *Walker ES, Levy F (2001).* Genetic trends in a population evolving antibiotic resistance. Evolution. 55(6): 1110-1122 DOI: 10.1111/j.0014-3820.2001.tb00631.x

THE NEW ARMENIAN MEDICAL JOURNAL
Volume18 (2024). Issue 3

CONTENTS

4. *Kalmatov R.K., Rahim F., Akhunbaeva T., Toguzbaeva K., Dzhusupov K*
CUBN GENE POLYMORPHISMS AND SUSCEPTIBILITY TO TYPE 2 DIABETES VERSUS TYPE 1 DIABETES: A SYSTEMATIC REVIEW

13. *Afroughi F., Padyab Z., Sharifi M., Salehnasab C., Afroughi S.*
PREVALENCE AND RISK FACTORS OF GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN: A CROSS-SECTIONAL STUDY IN SOUTHERN IRAN

22. *Harutyunyan K.R., Abrahamyan H.T., Adamyan S.H., Ter-Markosyan A.S.*
MECHANISM OF BACTERIAL LIPOPOLYSACCHARIDE EFFECT ON THE FUNCTIONAL ACTIVITY OF THE HEART IN VITRO. CORRECTION OF ITS EFFECTS BY THE CALCIUM REGULATING HORMONE SYSTEM

35. *Nourbakhsh S.M.K., Hashemi E., Kheyri M., Bahadoram M., Keikhaei B., Hassanzadeh S.*
COMPARISON OF LEPTIN AND FERRITIN LEVELS IN BETA-THALASSEMIA MAJOR AND HEALTHY INDIVIDUALS

42. *Ismailov I. D., Kalmatov R. K., Rahim F., Momunova A. A., Kilinç N.*
COMPARATIVE CHARACTERISTICS OF THE CONDITION OF TISSUE UPPER RESPIRATORY TRACT IN CHILDREN WITH RESPIRATORY DISEASES LIVING IN KYRGYZSTAN, LOCATED AT DIFFERENT ALTITUDES ABOVE SEA LEVEL

51. *Tadevosyan N.S., Poghosyan S.B., Muradyan S.A., Khachatryan B.G., Ter-Zaqaryan S.H., Kirakosyan G.V., Guloyan H.A., Babayan T.L.*
ENVIRONMENTAL POLLUTION OF SOME FOOTHILL REGIONS OF ARMENIA WITH ORGANOCHLORINE PESTICIDES AND ISSUES OF MORBIDITY

60. *Bari Md N., Osman E.H.A., Alfaki M.A. , Ansari Md R.*
NONINVASIVE PROTEOMIC BIOMARKER IN DISORDERS OF THE NONALCOHOLIC FATTY LIVER

68. *Bari Md. N., Ansari Md.R., Alfaki M.A.*
THE ROLE OF EVOLVING TECHNIQUES AND PROSPECTIVE IMPLICATIONS OF BIOMARKERS IN LIVER DISEASE

82. *Mohammad I., Khan M.S., Ansari M.R.*
GINGER REVITALIZED: EXPLORING THE MODERN APPLICATIONS OF ZINGIBER OFFICINALE IN MEDICINE AND BEYOND

93. *Mohammed I., Osman E.H.A., AlFaki M.A.M.*
ANTI-NEURODEGENERATIVE ACTIVITY OF THE PROBIOTIC STRAIN LACTOBACILLUS ACIDOPHILUS

99. *Poyil M.M., Shamna K. P., Raja K.*
COMBATING MULTI-DRUG RESISTANCE: POTENTIALS OF KALANCHOE PINNATA EXTRACTS AGAINST BACTERIAL PATHOGENS

106. *Qamer S., Bakar I., Alsanousi N.*
ANTIOXIDANT DRUGS FROM HYDRO-ETHANOLIC FLORAL EXTRACTS OF IMPATIENS BALSAMINA L.: AN IN VITRO ANALYSIS

112. *Saad Ahmed O., Saad Ahmed S., Talib Dheyab R.*
A COMPREHENSIVE EXERCISE PROGRAM IMPROVES FOOT ALIGNMENT IN CHILDREN WITH FLEXIBLE FLAT FOOT

119. *Bqlein A. S.*
COMPREHENSIVE REVIEW OF LABOR PAIN MANAGEMENT, PERINEAL TEARS, AND EPISIOTOMY COMPLICATIONS: A FOCUS ON PREVENTION AND THE ROLE OF NURSES

THE NEW ARMENIAN MEDICAL JOURNAL

Volume18 (2024). Issue 3

The Journal is founded by
Yerevan State Medical
University after M. Heratsi.

Rector of YSMU

Armen A. Muradyan

Address for correspondence:

Yerevan State Medical University
2 Koryun Street, Yerevan 0025,
Republic of Armenia

Phones:

(+37410) 582532 YSMU
(+37493 588697 Editor-in-Chief
Fax: (+37410) 582532
E-mail:namj.ysmu@gmail.com, ysmiu@mail.ru
URL:http//www.ysmu.am

Our journal is registered in the databases of Scopus, EBSCO and Thomson Reuters (in the registration process)

Scopus *EBSCO*
Reuters

Copy editor: Tatevik R. Movsisyan

Printed in "LAS Print" LLC
Director: Suren A. Simonyan
Armenia, 0023,Yerevan,
Acharyan St. 44 Bulding,
Phone: (+374 10) 62 76 12,
E-mail: las.print@yahoo.com