

Antimicrobial Activities of a Formulated *Dacryodes edulis* Plant Bark against Bacterial Isolates

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ABSTRACT

The need for alternative antimicrobial agents cannot be overemphasized as the rapid rise of antibiotic resistance has made this evident. This study investigates the antimicrobial potential of the crude extract derived from the bark of *Dacryodes edulis* against bacterial isolates. The *Dacryodes edulis* plant which is known for its medicinal properties contains bioactive compounds that exhibit potential antimicrobial activity. For the preparation of crude extract obtained from the bark of the plant, a solvent extraction technique was employed. The disc diffusion method was used to demonstrate the antimicrobial efficacy of the crude extract against selected Gram-positive and Gram-negative bacterial isolates. The results indicate that *Dacryodes edulis* demonstrate promising antimicrobial activity against bacterial infections as notable inhibitory effects was detected, with zones of inhibition varying according to the bacterial species and concentration of the extract. These findings highlight the importance of this medicinal plant as a natural alternative to conventional drugs, and most importantly its potential as a source of novel antimicrobial against bacterial infections.

Keywords: *Dacryodes edulis* bark; gram-negative bacteria; natural alternative; antimicrobial activities; zone of inhibition.

INTRODUCTION

Bacterial antimicrobial resistance has long been recognized as a major health challenge of the twenty-first century. This resistance (AMR) is as a result of bacterial alterations which reduces the effectiveness of medications and poses a threat to preventive treatment of bacterial infections. Due to this, there has been a significant growing interest in investigating new sources of antimicrobial agents to address the increasing challenges posed by the AMR (Akinkugbe *et al.*, 2020). Over centuries, people have utilized plants as a source of food and healing, one of which is *Dacryodes edulis*. *Dacryodes edulis* popularly known as "African pear", is used by the indigenous people for its nutritional and medicinal properties. It is known by different names among different tribes. In efik, it is known as "eben", "orumu" in Benin, "ube" in Igbo, "Elemi" in Yoruba and "safou" in French (Anselm *et al.*, 2021). In English, it is commonly known as the Bush butter tree, Bush butter, African pear, African pear tree, Bush fruit tree, Eben tree, and Native pear and in French, Safoutier or prunier (Rimlinger *et al.*, 2020). It belongs to the Burseraceae family.

According to Rimlinger *et al.* (2020), the name *Dacryodes* is derived from the Greek word Dakruon, meaning tear which refers to resin droplets on the bark surface of its members. *Edulis* which means edible, showcases the relevance of the nutrient rich fruit as a source of food. *Dacryodes edulis* is a dioecious shade loving plant species which can be found in humid tropical zone of non-flooded forests (Lennox and Agbo, 2020). It produces ellipsoidal fruit that ranges in size from 4 cm to 9 cm in length and 2cm to 5cm in width composing pulpy pericarp with seeds. The fruit is abundant in minerals, vitamins and lipids and can be consumed raw, cooked, roasted in hot ash or grilled in an oven (Ilesanmi *et al.*, 2022) consumption include eaten raw ,cooked ,roasted in hot ash , cooked in salt water or grilled in an oven and can be eaten raw or cooked (Ilesanmi *et al.*, 2022). This study aims to determine the efficacy of the potential antimicrobial properties of *Dacryodes edulis* against bacteria resistant to conventional drugs.

MATERIALS AND METHODS

Sample Collection

Dacryodes edulis samples were bought at Oja-Jagun market Ogbomoso, Oyo State, Nigeria and placed in sterile food grade containers. These were transported in a cool box to Microbiology Laboratory, Federal Polytechnic Ayede, Oyo State, Nigeria for analysis.

Preparation of *Dacryodes edulis*

The fruits were de-fleshed to separate the seed from the pulp. The fresh seed and pulp of *D. edulis* plant were dried in a shaded area. Afterwards, both samples were oven dried separately at 40°C for 5-10 minutes. The samples were ground to fine powder using a mechanical grinder.

Plant extraction procedure

After weighing, 150 g of powdered *Dacryodes edulis* sample was macerated for 48 hours in 450 mL of acetone. The mixture was then filtered using sterile muslin cloth to obtain the crude extract. The resulting crude was allowed to concentrate by evaporation in a dry, cool environment. Following evaporation, the crude extract was collected in a colloid and kept in a refrigerator at -4°C for antimicrobial analysis.

Revitalization of microorganisms used

The test species used include *Bacillus cereus* and *Staphylococcus aureus*, which are Gram-positive bacteria, as well as *Pseudomonas aeruginosa*, *Escherichia coli*, and *Klebsiella pneumoniae* which are gram-negative bacteria. *Streptococcus pneumoniae* and *Brahmella catarrhalis* were also among the tested microorganisms. All bacteria strains were supplied by Lautech Teaching Hospital, Ogbomosho, Oyo State, Nigeria. The isolates were resuspended at 37°C on nutrient agar plates and maintained at -4°C on nutrient agar slants.

Antimicrobial screening of crude extract

The crude extract obtained was screened for their inhibitory activity against selected bacteria strains.

Preparation of inoculum using MacFarland Standard

Six (6) test tubes were filled with 9 mL of nutrient broth each, these were autoclaved for 15 minutes at 121°C to sterilize it. Following sterilization, a loopful of the different bacteria inocula was added to each test tube holding 9 mL of nutritional broth, and the tubes were shaken briskly. Each organism's absorbance was measured at 600 nm after the inoculation nutrient broth has been incubated for a number of hours.

Preparation of different concentrations of crude extracts

Different concentrations of the crude extracts were prepared using the procedure described by Akomolafe *et al.* (2025). The concentrations were 100, 150, 200, 250 and 500 mg/ml.

Antibacterial analysis

The cell suspension of each bacterial species was introduced onto nutrient agar (NA) using a swab stick. Six millimeter (mm) filter paper discs were sterilized at 120°C for two hours. The sterilized discs were soaked in each crude extract solution at different concentrations as well as in the control solution. Following this, the impregnated discs were placed on the inoculated NA plates. The plates were incubated for 24 hours at 37°C. The Antimicrobial activity was assessed by measuring the zones of inhibition (mm).

Antibiotic susceptibility test on the collected bacteria

Standard antibiotic discs served as a positive control for the susceptibility test. According to NCCL, the Kirby Bauer method was used to assess the antibiotic activity of both Gram positive and Gram negative bacteria. The values for each concentration (n=2) were presented as mean \pm SD. At $p < 0.05$, $p < 0.01$, and $p < 0.01$, values with the symbols *, **, and *** are considerably greater than the control.

RESULTS

The results of the acetone extract of *Dacryodes edulis* at various concentrations against different clinical isolates of bacteria are presented below. The antibacterial activities are shown in the figures 1-5.

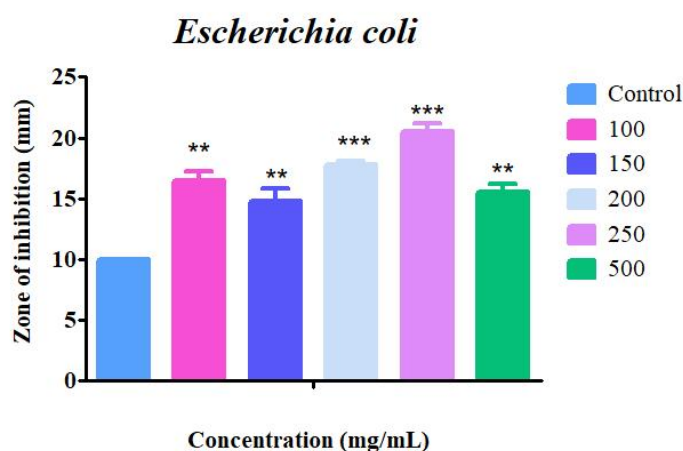


Fig 1: Antimicrobial activity of *Dacryodes edulis* against *Escherichia coli*

The result shown in figure 1 indicates that all the concentrations (100 mg/ml, 150 mg/ml, 200 mg/ml, 250 mg/ml and 500 mg/ml) had significant effects on the pathogenic isolates when compared with the control (which was ordinary acetone). This means that the plant extracts at different concentrations were able to inhibit the growth of the bacteria used. This also implies that the bacteria were susceptible to the plant extracts at different concentrations. However, the zone of inhibitions varied from one concentration to the other. Figure 1 shows concentration 250 mg/ml had the highest zone of inhibition (i.e this concentration had the highest effectiveness against *E. coli*), followed by 200 mg/ml while the least zone of inhibitions were concentrations 150 mg/ml and 500 mg/ml.

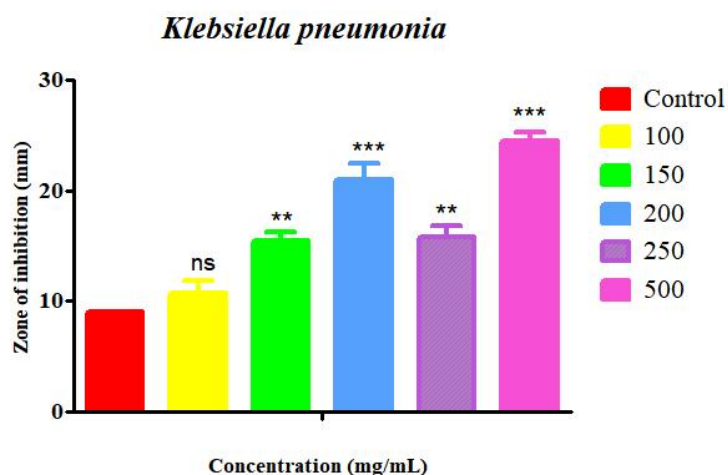


Fig 2: Antimicrobial activity of *Dacryodes edulis* against *Klebsiella pneumoniae*

Antibacterial effective activity of *Dacryodes edulis* at various concentrations against *Klebsiella pneumoniae* is shown in figure 1. The output of the result shows that 500 mg/ml concentration had the highest significant effectiveness when compared with the control. This indicates that *Klebsiella pneumoniae* was highly susceptible to this concentration. This clinical isolate was also susceptible to 200 mg/ml, 250 mg/ml and 150 mg/ml, whereas, 100 mg/ml had not significant activity against the bacteria.

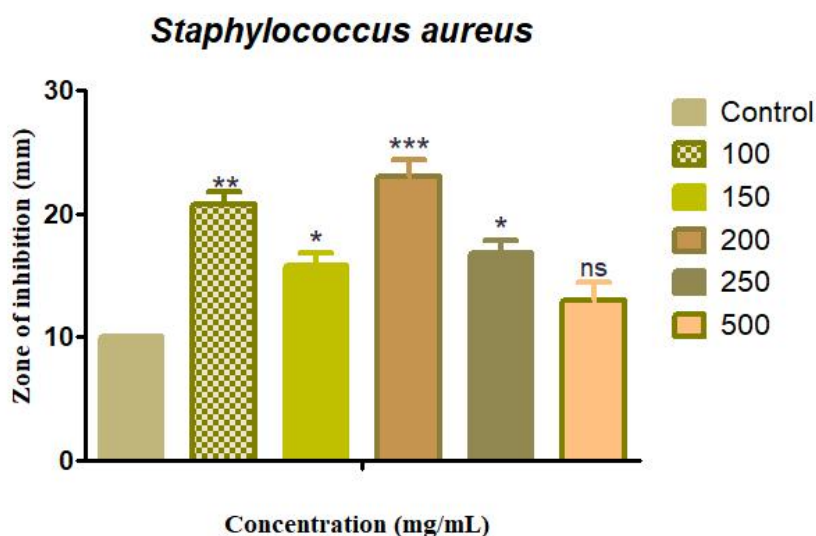


Fig 3: Antimicrobial activity of *Dacryodes edulis* against *Staphylococcus aureus*

The zone of inhibitions of the plant extract at different concentrations except for 500 mg/ml indicates that *Staphylococcus aureus* was susceptible to the acetone extract of *Dacryodes edulis* as shown in figure 3. The result shows that the highest significant plant activity was recorded at 200 mg/ml while least significant activity was at both 150 mg/ml and 250 mg/ml.

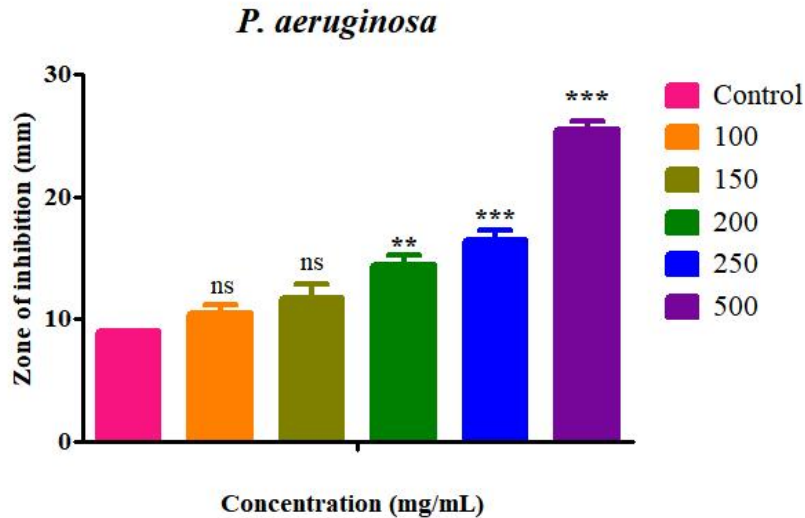


Fig 4: Antimicrobial activity of *Dacryodes edulis* against *Pseudomonas aeruginosa*

Furthermore, figure 4 shows the resistance and susceptibility of *Dacryodes edulis* at various concentrations against *Pseudomonas aeruginosa* which is a gram –ve bacterial clinical isolates. The result indicates that the isolate was susceptible to the plant extract at 500 mg/ml, 250 mg/ml and 200 mg/ml while it was resistant at other concentrations. However, the highest and least significant effective activity was recorded at 500 mg/ml and 150 mg/ml respectively.

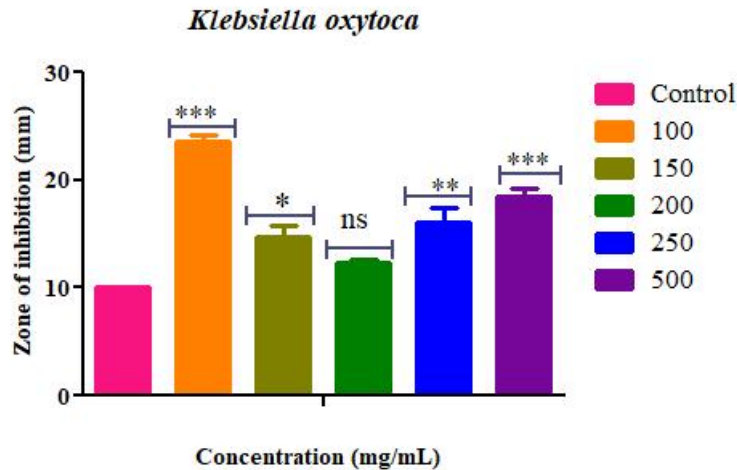


Fig 5: Antimicrobial activity of *Dacryodes edulis* against *Klebsiella oxytoca*

The significant effective antibacterial activity of *Dacryode edulis* at different concentrations against *Klebsiella oxytoca* is shown in the figure 5. The output shows that all the concentrations except 200 mg/ml had significant activities against the bacterial isolate. It indicates that 100 mg/ml had the highest zone of inhibitions followed by 500 mg/ml, 250 mg/ml and least was at 150 mg/ml.

DISCUSSION

Research has shown that the biological properties (i.e. anti-inflammatory, wound-healing and antimicrobial activities relevant to wounds, ringworm and skin infections) of various medicinal plants, including *Dacryodes edulis* are attributed to the presence of different bioactive compounds in these plants (Agu *et al.*, 2025). This study described the efficacy of *Dacryodes edulis* bark extract at different concentration against bacterial isolates. In comparison to the control, a statistical significant zones of inhibition of the extract was recorded. The data values of the zones of inhibition at different concentrations were quite higher than that of the control, this indicates a strong antimicrobial activity of *Dacryodes edulis*. This is in accordance with several studies which demonstrate the utilization of the part of *Dacryodes edulis* (e.g. root, stem, leaves, bark and oil) in the treatment of bacterial infections. Essential oil obtained from *Dacryodes edulis* possess a high antibacterial effect against bacteria like *Bacillus cereus*, *Proteus mirabilis*, *Escherichia coli*, *Salmonella enteric* and *Staphylococcus aureus* than its anti-fungal activity against *Candida albicans*, this is due to the presence and high content of α -pinene (17.4%) and terpinen-4-ol (19.8%) (Karaca *et al.*, 2023). In all the antibacterial activities, an equivalent of the Minimum Inhibitory Concentration (MIC) to the Minimum Bactericidal Concentration (MBC) of 1-16 mm was seen. In another study, the antibacterial action of the plant's essential oil was attributed to the high content of terpenes, however, no anti-fungal activities was found in the essential oils (Guimarães *et al.*, 2019). A proposed explanation for the antimicrobial activities of the plant, *Dacryodes edulis*, is attributed to the inclusion of bioactive substances such as saponins and alkaloids which are widely recognized for their antibacterial characteristics (Okpako *et al.*, 2023; Nwanagba *et al.*, 2024). After screening some indigenous plants, it was discovered that quercitrin and ethylgallate were responsible for the antibacterial activities of the leaf extracts.

CONCLUSION

The zone of inhibitions produced by *Dacryodes edulis* bark extract in this study frequently equals or surpasses the conventional antibiotics used, and this has proven the efficacy of the extract that it can be utilized as an alternative therapeutic option. This brings a confirmation to the traditional utilization of *Dacryodes edulis* and aligns it with current scientific research. This also added to the growing amount of data which supported the utilization of plant-based extracts in the treatment of bacterial infections. *Dacryodes edulis* bark extract possess a high antimicrobial properties which makes them potential natural antimicrobial agent. In the creation of novel antimicrobial drugs, it is important to investigate the natural resources such as the bark of a plant as highlighted in this study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest

REFERENCES

- Agu, M. O., Onyema, A. D., Yakubu, S. and Sylvester, O. C. (2025). Physicochemical, Proximate, Heavy Metals and Antimicrobial Assessment of Few Selected Herbal Medicinal Products Consumed in Awka, Anambra State, Southeastern, Nigeria. *Indonesian Journal of Green Chemistry*, 2(1), 1-11.
- Akinkugbe, O., Cooke, F. J. and Pathan, N. (2020). Healthcare-associated bacterial infections in the paediatric ICU. *JAC-Antimicrobial Resistance*, 2(3), 1-66.

- Akomolafe, S. F. (2025). Nutritional composition of three varieties of sweet potato (*Ipomea batata* L.) based diet commonly consumed in Nigeria: a comparative study. *Food Chemistry Advances*, 101067.
- Anselm, O. U., Nwachukwu, A. C., Saddam, G. A. and Uzochukwu, U. C. (2021). Effect of different storage conditions on the oxidative stability of African pear (*Dacryodes edulis*) pulp oil. *Journal of Advances in Food Science & Technology*, 8(2), 34-42.
- Guimarães, A. C., Meireles, L. M., Lemos, M. F., Guimarães, M. C. C., Endringer, D. C., Fronza, M. and Scherer, R. (2019). Antibacterial activity of terpenes and terpenoids present in essential oils. *Molecules*, 24(13), 24-71.
- Ilesanmi, T. M., Oladipo, O. O., Olaleye, A. C. and Osasona, O. D. (2022). Antimicrobial activity of essential oil from Avocado (*Persea americana*) seed and pulp on some pathogenic organisms. *South Asian Journal of Research in Microbiology*, 12(3), 61-68.
- Karaca, N., Demirci, B., Gavahian, M. and Demirci, F. (2023). Enhanced bioactivity of rosemary, sage, lavender, and chamomile essential oils by fractionation, combination, and emulsification. *ACS omega*, 8(12), 10941-10953.
- Lennox, J. and Agbo, B. (2020). Medicinal Properties of *Dacryodes edulis* against Selected Clinical Bacterial Isolates. *Current Research in Agriculture and Horticulture* 1, 27-35.
- Nwanagba, N. L., Ukom, A. N., Pipi, G. O., Jacob, Y., Okoli, J. N., Keke, J. U. and Ezehmalu, J. A. (2024). Evaluation of the Effect of Drying Methods on the Chemical Compositions and Antimicrobial Properties of Selected Leafy Spices. *Nigeria Agricultural Journal*, 55(3), 135-141.
- Okpako, I. O., Kyama, M. C. and Njeru, S. N. (2023). Phytochemical screening and gas chromatography-mass spectrometry analysis of *Euphorbia ingens* organic root extract. *Journal of Medicinal Plants Research*, 17(3), 100-105.
- Omosimua, R. O., Macham, B. D., Onanuga, A., Thomas, B. T., Ugbomor, C. O., Iyappan, G. and Thomas, S. A. (2020). Anti-oxidant and Anti-microbial Activities of Flavonoids from the Fruit Extract of *Dacryodes edulis*. *In Phytomedicine* (pp. 131-137). CRC Press.
- Rimlinger, A., Marie, L., Avana, M. L., Bouka, G. U. D., Zekraoui, L., Mariac, C. and Duminil, J. (2020). New microsatellite markers for *Dacryodes edulis* (Burseraceae), an indigenous fruit tree species from Central Africa. *Molecular Biology Reports*, 47(3), 2391-2396.