

Original Research Article

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## Assessment of the Antimicrobial Activities of *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* Barks in Burkina Faso

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### ABSTRACT

Several plants in Africa, particularly in Burkina Faso, serve as therapeutic healing tools due to their health benefits. Among these plants, we can cite *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa*; the knowledge of their different therapeutic properties remains uncertain. The objective of this study was to verify in vitro the antimicrobial activity of *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* barks on multi-resistant clinical bacteria strains isolated from the Yalgado Ouédraogo University Hospital (CHU-YO) patients in Ouagadougou. A survey was carried out among herbal tea sellers in four markets in Ouagadougou on the use of these plants. Sampling consisted of taking the plant barks and their transformation into extracts by maceration. Microdilution has been used to study the antimicrobial properties of the barks of these plants. The plant extracts were tested on four pathogenic strains: *Bacillus cereus*, *Escherichia coli*, *Salmonella typhi*, and *Staphylococcus aureus*. *Vittelaria paradoxa* showed more effectiveness on *Bacillus cereus* than *Lannea microcarpa* and *Parkia biglobosa*. For the *Escherichia coli* strain, the extract of *Vittelaria paradoxa* had more antimicrobial properties than that of *Parkia biglobosa* and of *Lannea microcarpa*. The different extracts had low activity against *Staphylococcus aureus* and no effect on *Salmonella typhi*. From this study, we can say that *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* extracts have antibacterial activities on pathogenic strains such as *Bacillus cereus*, *Escherichia coli*, and *Staphylococcus aureus*. The *Salmonella typhi* strain has shown itself to be resistant to these extracts.

#### Keywords

*Lannea microcarpa*,  
*Parkia biglobosa*,  
*Vittelaria paradoxa*,  
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### Introduction

In Africa and more particularly in Burkina Faso, several plants are used as means of therapeutic healing because

of the benefits they provide to human health (Gbedomon *et al.*, 2016; Heubach *et al.*, 2011). More than 80% of rural populations in West Africa use natural plants for health care (Shinkafi *et al.*, 2015; Guedje *et al.*, 2010).

This situation is based on traditional medical knowledge imbued with local culture (Shinkafi *et al.*, 2015). The development of this traditional medical knowledge offers many potentialities and perspectives in terms of care for African countries. In recent years, new resistance mechanisms are emerging and spreading worldwide, compromising our ability to treat infectious diseases (Zahar *et al.*, 2016). An increasing number of infections are becoming more difficult to treat, sometimes even impossible, due to the loss of effectiveness of antibiotics (Compaoré *et al.*, 2016). This phenomenon of antibiotic resistance associated with the constantly high cost of available drugs has sparked renewed interest in traditional pharmacopoeia (Konan *et al.*, 2013; Akoua *et al.*, 2014). Plants contain a very large number of molecules that can have varied or even synergistic pharmacological modes of action against microorganisms. Indeed, *Lannea microcarpa* (grape), *Parkia biglobosa* (nééré), and *Vitellaria paradoxa* (shea) are examples of plants that have therapeutic virtues that we could use. *Parkia biglobosa* is a species from the Sudanian savannah that can measure up to 25 m high (Kambou *et al.*, 2000). The bark of *Parkia biglobosa* is used to treat liver cancer, treat diarrhea, or relieve stomach pain (Pouliot *et al.*, 2012). *Vitellaria paradoxa* is a tree that grows in the savannah in West and Central Africa. It is a deciduous tree measuring between 10 and 15 meters (Bothon *et al.*, 2023). *Vitellaria paradox* bark is used to treat liver cancer and relieve stomach pain.

It is also used to treat diarrhea. *Lannea microcarpa* has a terminal cluster inflorescence reaching 15 cm, dotted with glandular points. It is traditionally used as a medicine for many diseases such as mouth blisters, rheumatism, dysentery, sore throat, like boils, like cathartic, diarrhea, gastroenteritis, malaria, bacterial infections, toothache, blood pressure, edema, cough, poisoning, and burns (Mangla *et al.*, 2021). Medicinal plants contain a very large number of molecules that can have varied or even synergistic pharmacological modes of action against microorganisms (Konan *et al.*, 2013; Akoua *et al.*, 2014; Compaoré *et al.*, 2021). In Burkina Faso, several studies have been carried out on these medicinal plants commonly used for various treatments, such as the work of Zerbo *et al.*, (2007) and Ouoba *et al.*, (2023) on the use of medicinal plants in health care. However, little scientific data exists on the antimicrobial properties of the barks of these plants of interest, hence the objective of this work, which consists of verifying *in vitro* the antimicrobial properties of *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* barks on

multi-resistant bacteria strains isolated from Yalgado Ouédraogo University Hospital Center (CHU-YO) patients.

## Materials and Methods

### Sampling and collection of plant barks

A survey was carried out among herbal tea sellers in several markets in the city of Ouagadougou. In total, four (04) markets were visited, with ten sellers interviewed per market. The choice of these sellers was made randomly. The survey was carried out on the basis of a standardized questionnaire. It consisted of an interview with them. The various parameters noted during the investigation were as follows: the use of the barks of the grape tree, shea, and nééré is used for the treatment of certain diseases, how they are used, and the diseases that the barks of these plants can treat.

The biological material used for this study consists of *Lannea macrocarpa*, *Parkia biglobosa* and *Vittelaria paradoxa* barks (Figure 1) and also pathogenic strains of *Bacillus cereus*, *Escherichia coli*, *Salmonella typhi*, and *Staphylococcus aureus* offered by the Yalgado Ouédraogo University Hospital Center (CHU-YO). These are strains that are multi-resistant to certain antibiotics and have caused therapeutic failures. It consisted of taking the bark of studied plants in four different areas. The samples were taken very early, before sunrise. The sample collection sites are: Boassa, Tanghin Dassouri, Komsilga, and Kienfangué (Figure 2).

### Period and study site

The study took place from July 2023 to September 2023, at the microbiology laboratory of the Department of Food Technology (DTA) and at the Institute of Applied Sciences and Technologies Research (IRSAT) of the National Center for Scientific and Technological Research (CNRST), Ouagadougou (Burkina Faso).

### Stains reviving

Four (04) pathogenic strains were used for the analysis of the extracts antimicrobial activities. These were *Salmonella typhi*, *Bacillus cereus*, *Staphylococcus aureus*, and *Escherichia coli*. These bacterial strains were stored as frozen culture stocks at -80 °C in broth supplemented with 20% glycerol. Before use, the bacteria were revived in the nutritional broth.

### Preparation of aqueous extracts

The aqueous extracts were obtained by maceration of 100 g of plant bark in 400 ml of sterile distilled water for 5 h. After dissolution, the supernatant was purified by centrifugation and then filtered with 0.22 µm millipore filters.

### Seeding of microorganisms

Indicator microorganisms were cultured in nutrient broth and incubated at 37 °C/ for 24 hours. 100 µl of microbial culture was used to inoculate Muller-Hinton agar into Petri dishes, then left to solidify.

### Preparing the discs

The disk diffusion method described by Kholkhal (2005) was used. The blank antibiotic discs of 5 mm in diameter were loaded by imbibition for 15 min in 150 µl of each extract to be tested at a concentration of 25 mg/ml.

After drying in an oven at 45°C, they were placed on the surface previously seeded with pathogenic microorganisms. The diameters of the inhibition zones were measured to the nearest millimeter after 24 hours, 48 hours, and 72 hours of incubation. The tests were repeated three times.

### Statistical analysis

All the data were entered with Excel and used to draw the graphs and tables.

### Results and Discussion

For the survey results, 90% of our respondents responded that they had used the bark of these plants for the treatment of certain illnesses, and 70% responded in the affirmative that these plants were used to treat certain illnesses. 100% of respondents responded in the affirmative that they boiled these barks to extract the maximum amount of compound (table 1).

According to the results, the majority (more than 50%) of sellers of these barks recognized the effectiveness of these plants in the treatment of certain diseases such as gastric ulcers, hemorrhoids, tension, colopathy, diabetes, itching etc. Indeed, surveys of herbalists in the central-west region by Savadogo *et al.*, (2019) had shown that

medicinal plants are used in the treatment of certain diseases, such as the bark of the *Lannea microcarpa* plant. Studies carried out by Koné *et al.*, (2004) showed that *Parkia biglobosa* was effective against microorganisms such as *Salmonella typhi*.

According to Dibong *et al.*, (2011), the use of bark for treatment is justified by the centuries-old idea of traditional practitioners, according to which "the bark is stronger than the other parts of the plant." Knowledge of the uses of medicinal plants and their properties is generally acquired following long experience accumulated and transmitted from one generation to another, and, moreover, the virtues of plants are ancestral knowledge that is transmitted from generation to generation (Klotoé *et al.*, 2013; Benlamdini *et al.*, 2014).

### Antimicrobial activity of the extracts on the tested strains

The results of testing the antimicrobial activity of extracts of *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* on the tested strains are presented in Figure 3.

It appears that the aqueous extract of these plant barks presents inhibition diameters of at least 14 mm on three bacteria (*Bacillus cereus*, *Escherichia coli*, and *Staphylococcus aureus*) tested after 24 hours of incubation.

In these results, each of these extracts has a fairly well-defined activity on the growth of *Bacillus cereus*, *Escherichia coli*, and *Staphylococcus aureus* in 24 hours, 48 hours, and 72 hours. However, we don't see that any of these extracts have inhibitory activity on the *Salmonella typhi* growth (Figure 4).

The extracts of these plants induced a significant zone of inhibition on pathogenic strains except the *Salmonella typhi* strain. For the *Bacillus cereus* strain, the results showed that the extract of *Vittelaria paradoxa* would have more antimicrobial properties, respectively, than that of *Lannea microcarpa* and *Parkia biglobosa*. Which indicates the effectiveness of these extracts in inhibiting the growth of this bacteria.

For the *Escherichia coli* strain, the extract of *Vittelaria paradoxa* had more antimicrobial properties than that of *Parkia biglobosa* and that of *Lannea microcarpa*.

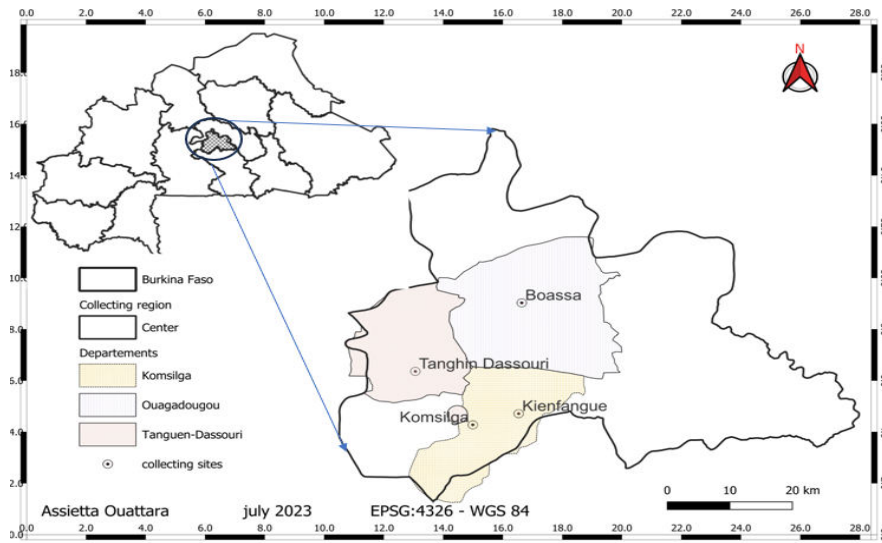
**Table.1** Percentages of survey responses

	<i>Lannea microcarpa</i> ,	<i>Parkia biglobosa</i>	<i>Vittelaria paradoxa</i>	<i>Pourcentage moyenne</i>
Use of plant bark	90%	95%	85%	90%
Use of bark to treat diseases	60 %	75%	75%	70%
Use of these barks	100%	100%	100%	100%

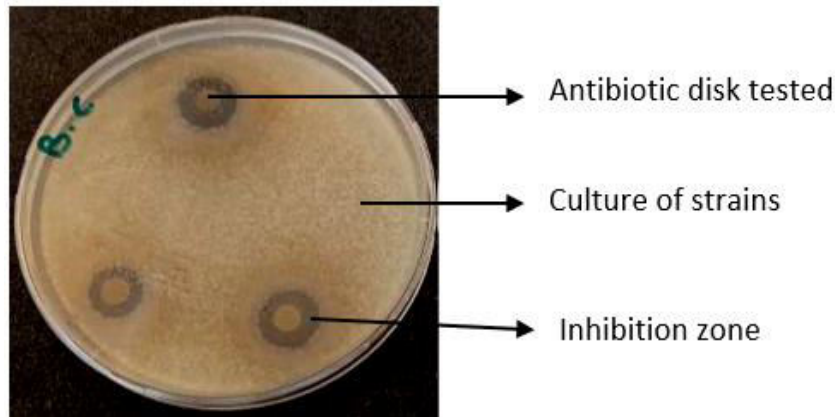
**Figure.1** Bark of *Vittelaria paradoxa*(A), *Parkia biglobosa*(B), *Lannea microcarpa*(C)



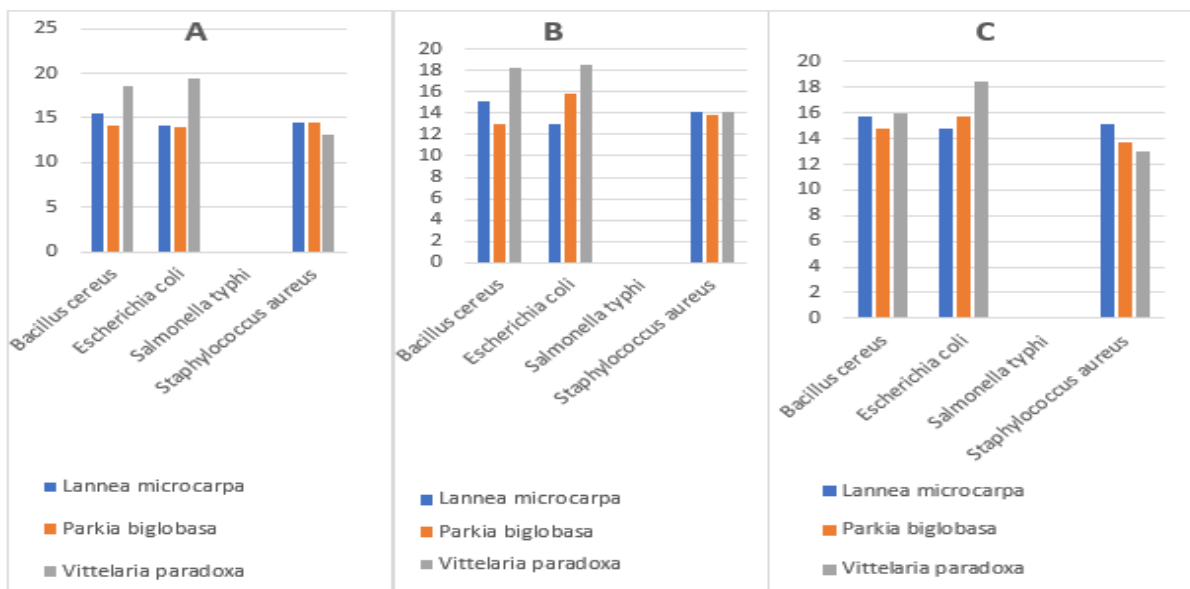
**Figure.2** Sampling sites



**Figure.3** Demonstration of extracts plants antimicrobial activities on *Bacillus cereus*



**Figure.4** Antimicrobial activity of *Lannea microcarpa*, *Parkia biglobosa* and *Vittelaria paradoxa* extracts in 24 hours (A), 48 hours (B) and 72 hours (C) on strains of *Bacillus cereus*, *Escherichia coli*, *Salmonella typhi* and *Staphylococcus aureus* strains



Aqueous extracts also affect the growth of Gram+ bacteria than that of Gram- bacteria. Compaoré *et al.*, (2021), found similar results with *Vachellia nilotica* extracts on *Staphylococcus aureus*, *Bacillus cereus*, *Shigella dysenteriae* and *Salmonella typhimurium*.

For the *Staphylococcus aureus* strain, the extracts had low effectiveness. The different extracts had no effect on *Salmonella typhi*. This could mean that the antimicrobial substances extracted from these plants have no effect on the strain of *Salmonella typhi* which is also resistant to several classic antibiotics. The lack of antimicrobial

activity against *S. typhi* may also mean that the concentration of the plant extract is too low to inhibit the growth of the strain.

According to Dibong *et al.*, (2011), medicinal plants contain pro-inhibitors such as alkaloids and quinones whose metabolites reduce or completely stop the *in vitro* development of microorganisms, particularly the organs (barks), which are the richer in secondary metabolites and constitute the basic materials.

In conclusion, it appears from this study that the aqueous

extracts of *Lannea microcarpa*, *Parkia biglobosa*, and *Vittelaria paradoxa* are effective in inhibiting certain microorganisms responsible for diseases such as *Bacillus cereus*, *Escherichia coli*, and *Staphylococcus aureus*. This reflects the therapeutic properties traditionally attributed to these plants. It should also be noted that *Salmonella typhi* was resistant to the three extracts tested. This may be due either to poor extraction of the properties or that the bacteria is resistant to the properties of these plants. The aim of this study being to promote the preservation of plants in general and medicinal plants in particular, it is appropriate to provide operators with guidance on harvesting techniques that destroy these resources less and especially on the techniques of their production.

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### Author Contributions

Hamidou Compaorè: Investigation, formal analysis, writing—original draft. Dissinviel Stéphane Kpoda: Validation, methodology, writing—reviewing. Serge Samandoulougou:—Formal analysis, writing—review and editing. Assièta Ouattara: Investigation, writing—reviewing. Dinanibè Kambirè: Resources, investigation writing—reviewing. Patindè Jules Tientrèbègo: Validation, formal analysis, writing—reviewing. Adama Parè: Conceptualization, methodology, data curation, supervision, writing—reviewing the final version of the manuscript. Cheik Amadou Tidiane Ouattara: Investigation, formal analysis, writing—original draft. Sawadogo/Lingani Hagrétou: Validation, methodology, writing—reviewing. Sidiki Aboubakar Ouattara:—Formal analysis, writing—review and editing.

### Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Declarations

**Ethical Approval** Not applicable.

**Consent to Participate** Not applicable.

**Consent to Publish** Not applicable.

**Conflict of Interest** The authors declare no competing interests.

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