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RESEARCH ARTICLE

Nutritional Content and Antimicrobial Activities of Latex from *Artocarpus heterophyllous* Lam. on a Few Bacterial and Fungal Species

Ananya Mishra, Sagarika Parida*

Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Bhubaneshwar Odisha, India

Study Area: Bhubaneshwar, Odisha, India
Coordinates: 20.27°N 85.84°E

Key words: Crude latex, Herbal product, Mineral elements

Abstract

Plant latex is a natural product produced by a number of plant species which are used by different tribal communities in India as a folk medicinal treatment for natural wounds or cuts. Plant latex has a huge demand as an herbal product in an aspect of clinical, therapeutical and also in agricultural sectors. Natural latex is composed of different important biomolecules like tannins, flavonoids, glycosides, sterols, saponins etc. These different active chemical constituents have versatile medicinal activities against different pathogens such as bacteria, fungi, viruses and protozoans etc. At present no literature is found on the antimicrobial activity of the latex *Artocarpus heterophyllous* Lam. Therefore, the present study aims to analyse the elemental composition of the latex of *A.heterophyllous* Lam. and also the screening of latex against selected bacterial and fungal species. Ten mineral elements were detected in the latex with a maximum amount of potassium. The crude latex was most active against all the tested bacterial and fungal strains than aqueous extracted latex.

Introduction:

Artocarpus heterophyllous Lam. belongs to the family Moraceae and is commonly called jack fruit. This plant possesses bioactive molecules as a therapeutic agent with antimicrobial, anti-inflammatory, anti-cancer, anti-leprosy and wound healing activity. These active phytochemicals have been used to combat the harmful side effects of conventional medicines and antibiotics because of their safety margins, affordable prices and ease to reach the common people (Rios & Recio, 2005). All the parts of the trees are extensively used in traditional medicines because of their antimicrobial, anticarcinogenic, anti-inflammatory and wound healing properties (Ranasinghe *et al.*, 2019). Leaves and fruit waste is used as fodder for cattle, raw fruits are used as vegetables and ripe fruits are consumed as seasonal fruits. Jack fruit is rich in nutrients, vitamins and minerals. Boiled or roasted seeds are consumed because of their high nutritional value. Heartwood is used as timber and is highly valued for its durability because of its anti-termite properties (Arung *et al.*, 2006). Latex of this plant is used in the treatment of ophthalmic disorders, dystopia and pharyngitis. The latex also is used as an antibacterial agent (Sato & Fujiwara, 1966). Latex is mixed with vinegar and applied in the healing of glandular swellings, snake bites and abscesses (Prakash *et al.*, 2009).

This plant contains artocarpin, cycloartocarpin, isoartocarpin, morin, dihydromorin, betulinic acid, artocarpanone, norartocarpin etc which is important in fever, skin diseases, constipation, ophthalmic disorders boils and wound healing (Prakash *et al.*, 2009). The fruit pulp is a dietary source of antioxidants which can survive the gastrointestinal digestion process (Zhu *et al.*, 2019). Reports were available on the antibacterial activity of crude methanolic extract of stem heartwood, root bark, root heartwood, leaves, fruits and seeds of *A.heterophyllous* Lam. which belongs to the mulberry family 'Moraceae' (Khan *et al.*, 2003). But no reports were available on the antimicrobial activity of latex of *A.heterophyllous.* Latex of *A.heterophyllous* is known to be useful in ophthalmic disorders, and pharyngitis and is also reported to have antibacterial activity (Sato & Fujiwara, 1996). Reports were not available on the antimicrobial activity of latex of *A.heterophyllous*. Therefore, this study was conducted and is the first report for the assessment of antimicrobial activity of *A.heterophyllous* latex against seven bacterial

*Corresponding Author: *sagarika.parida@cutm.ac.in*

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strains viz., *Escherichia coli* MTCC 614, *Proteus mirabilis* MTCC 9242, *Pseudomonas aeruginosa* MTCC 1036 and *Staphylococcus aureus* MTCC 7443, *Klebsiella pneumonia* MTCC 109, *Salmonella enterica typhimurium* MTCC 98 and *Serratia marcescens* MTCC 4822 and five fungal species such as *Candida albicans* ATCC 10231, *C.krusei* ATCC 14243, *C.tropicalis* MCC 1559, *Trichophyton mentagrophytes* MCC 1598 and *Colletotrichum truncatum* ITCC B10015.

Materials and methods

Collection of latex: latex from *A.heterophyllous* was collected from the kitchen garden of Centurion University, Bhubaneswar campus. The plants were identified and authenticated at the Herbarium unit of the Department of Botany, Centurion University of Technology and Management. Latex was collected in the morning hour.

X-Ray Fluorescence (XRF) for Macro and Micro-nutrient analysis: the different elements present in the selected plants were investigated qualitatively by using X-ray Fluorescence (XRF) technique. It is a common method to determine the qualitative and quantitative elemental composition of all kinds of materials. In XRF analysis, the sample is irradiated with an X-ray produced by a source in the instrument. Analysis was done using the instrument computerized sequential X-ray Fluorescence Spectrometer of AXIOS model equipped with X-ray tube of Rh and flow proportional counter and scintillation as a detector.

Bacterial and Fungal Cultures: cultures of different bacterial strains *viz.*, *Escherichia coli* MTCC 614, *Proteus mirabilis* MTCC 9242, *Pseudomonas aeruginosa* MTCC 1036, *Klebsiella pneumonia* MTCC 109 and *Staphylococcus aureus* MTCC 7443 were obtained from the stock cultures from Microbiology department, Utkal University, Bhubaneswar, Odisha and *Salmonella enterica typhimurium* MTCC 98 and *Serratia marcescens* MTCC 4822 were obtained from the stock cultures from the Department of Microbiology, Orissa University of Agriculture and Technology Bhubaneswar, Odisha.

Media preparation for Microbe culture growth: nutrient agar was taken for bacterial strains *Escherichia coli* MTCC 614, *Klebsiella pneumonia* MTCC 109, *Proteus mirabilis* MTCC 9242, *Staphylococcus aureus* MTCC 98, *Pseudomonas aeruginosa* MTCC 1036. Potato dextrose agar (PDA) media was used for fungal strains *Candida albicans* ATCC 10231, *C.krusei* ATCC 14243, *C.tropicalis* MCC 1559, *Trichophyton mentagrophytes* MCC 1598 and *Colletotrichum truncatum* ITCC B10015. Antimicrobial activity was assessed by agar well diffusion method. The test microorganisms were incubated at 25º C for 72 hours. Then the zone of inhibition was recorded.

Results and Discussion:

Elemental Composition: freshly collected latex was analyzed using the XRF method to find out the number of elements present. The results clearly revealed the presence of 10 mineral elements (Table 1; Fig. 1) with a normalisation factor of 3.14. These identified elements were bromine (Br), calcium (Ca), chlorine (Cl), iron (Fe), potassium (K), manganese (Mn), phosphorus (P), and rubidium (Rb), sulphur (S) and silicon (Si). Potassium was detected in a maximum quantity of 7mg per ml of latex followed by sulphur (S), phosphorus (P), chlorine (Cl) and silicon (Si) with 2.49, 1.39, 1.28 and 0.97 mg/ml of latex respectively (Fig.-1 & Fig.-2).

Table 1. Elemental analysis of *A.heterophyllus* latex (mg/ml)

Elements	*A.heterophyllus*	Elements	*A.heterophyllus*
Br	0.016	Ca	0.514
Cl	1.28	Fe	0.045
K	7.0	Mn	0.012
P	1.39	Rb	0.008
S	2.49	Si	0.97

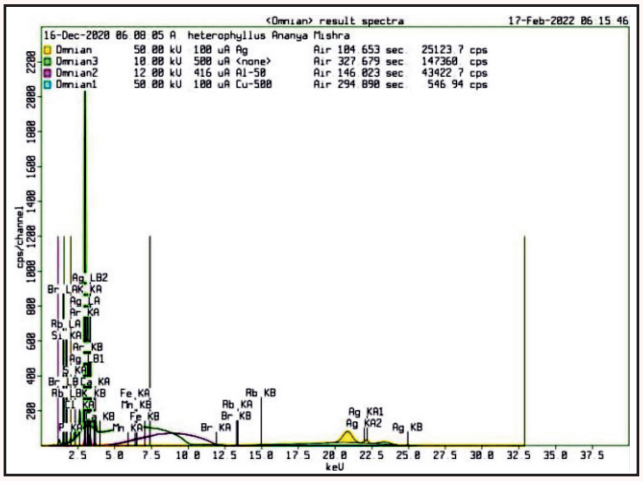

Figure-1: XRF graph showing mineral contents of *A.heterophyllous* Lam. latex

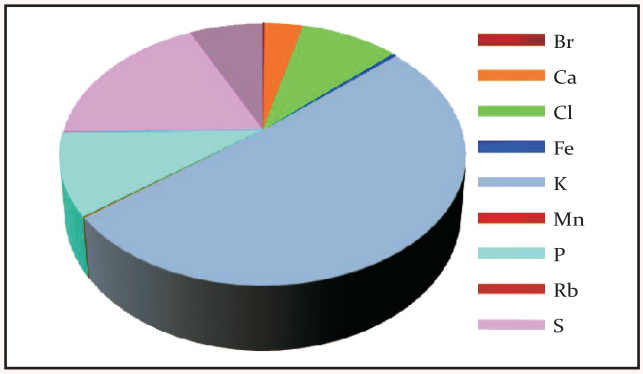

Figure-2: Mineral contents of *A.Heterophyllous* latex

Antibacterial activity of plant latex: antibacterial activity of crude and aqueous extracted latex of *A.heterophyllous* Lam. against seven above-mentioned bacterial strains of the human pathogen were evaluated by agar well diffusion method. The test microorganisms are incubated at 30º C for 24 hrs and a maximum zone of

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inhibition was observed in *Klebsiella pneumonia* MTCC 109 followed by *Pseudomonas aeruginosa* MTCC 1036, *Proteus mirabilis* MTCC 9242, both *Escherichia coli* MTCC 614 and *Serratia marcescens* MTCC 4822 with same inhibition zone respectively and least zone of inhibition was detected in *Salmonella enterica typhimurium* MTCC 98 for a crude extract of *A.heterophyllous* while *Klebsiella pneumonia* MTCC 109 showed maximum inhibition zone by aqueous extract with equal volume by volume (v/v) ratio (Table-2).

Table-2: Antibacterial activity of *A.heterophyllus* Lam. latex

Bacterial species	A*	B**
Escherichia coli MTCC 614	20 ±1*	12.33±0.58
Klebsiella pneumonia MTCC 109	25.67±1.53	17±1
Proteus mirabilis MTCC 9242	21.33 ±1.53	14±1
Pseudomonas aeruginosa MTCC 1036	22.67±1.53	12.67±0.58
Salmonella enterica typhimurium MTCC 98	15 ±1	9.33±0.58
Staphylococcus aureus MTCC 7443	16 ±1	9.66±0.58
Serratia marcescens MTCC 4822	20 ±2	10.33±1.15

Table-3: Antifungal activity of *A.heterophyllus* Lam. latex

Fungal species	A*	B**
Candida albicans ATCC 10231	25.33±1.53*	18.67±0.58
C.krusei ATCC 14243	22.33 ±1.15	16±1.73
C.tropicalis MCC 1559	17.67 ±1.53	10.33±1.15
Trichophyton mentagrophytes MCC 1598	15.67 ±1.53	10.67±0.58
Colletotrichum truncatum ITCC B10015	21.67 ±1.53	10.33±1.15

A*-Zone of inhibition/ (Crude extract) (mm)
A**-Zone of inhibition/ (Aqueous extract) (mm)
(Average Inhibition zone of triplicate) ±* Standard Deviation

Antifungal activity of plant latex: crude latex of A. heterophyllous Lam. showed potent activity against all the tested fungal strain *viz*., *Candida albicans* ATCC 10231, *C.krusei* ATCC 14243, *Colletotrichum truncatum* ITCC B10015, *C.tropicalis* MCC 1559 and *Trichophyton mentagrophytes* MCC 1598 in comparison to aqueous extract by agar well diffusion method through streaking and cotton swab method (Table-3). The test micro organisms are incubated at 25º C for 72 hr. Zone of inhibition was observed.

The XRF analyses of latex showed to contain high amount of potassium. The crude methanolic extract of stem, stem barks, root, root barks, fruits, leaves and seeds their subsequent partitioning with ethyl acetate, petrol, butanol and dichloromethane resulted fractions which showed antibacterial activity but none were tested active against any fungal species (Khan *et al*., 2003). Butanol fractions of fruits and root bark showed antibacterial activity.

Finally, the medicinal plants are the source of potential antimicrobial crude drugs and also are the source of natural compounds which can be used as anti-infection agents. The elemental analyses of latex proved as a good source of potassium. The crude latex of *A.heterophyllus* Lam. and aqueous extract exhibited a broad spectrum of antibacterial and antifungal activity against the tested bacterial and fungal type strain. Latex of the plant can be useful as antimicrobial agents but the establishment of a standard method is essential and further research should be carried out to find out the most active fraction responsible for an anti-infective agent.

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