Phytochemical Analysis and Antimicrobial Screening of *Artocarpus altilis*: Guyana Flora Extracts

ABSTRACT

The plant material leaves of *Artocarpus altilis* (Breadfruit) were collected from university of Guyana road, Cummings lodge, Guyana. Leaves were dried in oven at 50-55 ºC for 72 h. The moisture content is calculated. The dried leaves were grounded and extracted in each acetone, ethanol and methanol solvents. Extracts were collected and evaporation of solvent was done on rotavapour. The respective solvent was added to viscous semi solid liquid extract to make up the desired volume of extract solution. The antimicrobial and antifungal activity of both plants were examined by well diffusion method, poison plate method, paper disc plate method and streak plate methods. In *Artocarpus altilis*leaves extract studies, maximum and minimum antimicrobial potential was observed for methanol and acetone solvent extracts, respectively. All plant extracts showed antimicrobial potential toward the organisms Staphylococcus aureus, Escherichia coli and *Candida albicans*. The phytochemical analysis of methanol leaves extract of breadfruit tested positive for flavonoids, terpinoids, phenol, phlobatannins, steroids and phytosteroids and negative for tannins,saponins , alkaloids and cardiac glycosides .

Keywords: *Artocarpus altilis*; Leaves extract; Phytochemical screening; Antifungal potential; Antimicrobial potential.

1. INTRODUCTION

"According to DNA fingerprinting studies, the wild seeded ancestor of breadfruit is the breadfruitis the breadnut (*Atrocarpuscamansi*) which is native to New Guinea, the Maluku Islands, and the Philippines. It was one of the canoe plants spread by Austronesian voyagers around 3,000 years ago into Micronesia, Melanesia, and Polynesia, where it was not native" [1,2]. Extent of the Austronesian expansion that carried crops like breadfruit, bananas and

coconuts throughout the Indo-pacific Islands.Breadfruit trees growth to a height of 26 m (85 ft.). The large and thick leaves are deeply cut into pinnal lobes. All parts of tree yield latex [3] which is useful for boat caulking. Flower on an urban cheal axis is male while arising from single point is female. Fruit is cylindrical 9- 29 cm. long by 6 – 20 cm wide. They are normally green while yellow brown on ripe. Average weight of fruit is about 1 to 5 kg.Breadfruit tree with fruit and leaves is shown in Figure 1.

Figure 1. Breadfruit tree with leaves and fruits

"Breadfruit contains phytochemicals having potential as an insect repellent" [4].Sivagnana Sundaram and Karunanayeke [5] has investigated"phytochemical screening and antimicrobial activity of Artocarpus heterophyllus and Artocarpus altilis leaf and stem hexane, dichloromethane and ethanol extracts". "The local uses of paparahua (Artocarpus altilis) in

Amazonia Ecquadoreby phytochemical data review is reported"by Luzuriaga-quichimbo *et al.* [6]. The plant is found to contain terpenoid, stelbenoid and different groups of flavonoids which is effective in a search of novel drugs. Riasari*et al.* [7] studied "antibacterial and antifungal activities methanol extracts of green, fallen yellow, fallen dry breadfruit leaves against Escherichia coli, Staphylococcus epidermidis, propionbacterium acnes and candida albicans". Pradhan *et al*. [8] has explained "phytochemical screening and comparative bioefficacy assessment of *Artocarpus altilis* petroleum ethane, methanol and ethylacetate leaf extract for antimicrobial activity".Mbaeyi-Nwaoha and Onwuku [9] also evaluated"the antimicrobial properties and phytochemical composition of ethanolic,hexane and watery leaf extract of *Artocarpus altilis.* The anti-nutrient analysis of leave extract revealed the presence of phylate,oxalate, tannin and cyanide".Palupi et al. [10] studied "anti-inflammatory, antioxidant and immunosuppressant properties of ethanolic extract of leaf, fruit and bark from *breadfruit* (*Artocarpus altilis* [Park] Fosberg). This result indicated the *A. altilis* leaf extract significantly revealed anti-inflammatory, antioxidant and immunosuppressant activities at 200 mg/kg".

Gladys and Bukola [11] has reported that "methanol extract of the leaf, root, stem, bark, flower, fruit and wood of A. altilis was tested against the fourth instar larvae of culex quinquefasciatus mosquito".Nisa *et al.* [12] has evaluated "antifungal and antibacterial activity of ethanolic and distilled water extracts of *Artocarpus altilis*plant using broth micro-dilution methods. Aaltilis aqueous extract had the most significant antifungal activity against Penicilliumsp with AFA value of 140.36 ± 3.76%".Nochera and Ragone [13] has investigated to develop a pasta product using breadfruit flour, test the sensory qualities of the breadfruit pasta product by sensory evaluation, and evaluate the nutritional composition.Ranteet *al.*[14] has studied $\propto$- glycosidase inhibitory activities of n- hexane and ethanolic, yellow and green breadfruit leaves extract

ethanoic leaf extracts were found to have more ∝-glycosidase inhibitory activity than n- hexane leaf extract.

Nayagam*et al*. [15] has synthesized silver nanoparticles (AgNPs) from plant residue of breadfruit and analyzed for the antibacterial assay against human pathogens. The cytotoxic activity AgNPs was analyzed with two human cancer cell lines namely MCF_7 lung cancer cell line and A594 breast cancer cell line.Marta *et al.* [16] has compared the effectof different thermal treatment viz heat moisture treatment (HNT), and osmotic pressure treatment (OPT) on physicochemical and pasting properties of breadfruit starch.Soifoini*et al*. [17] has described "nutritional and nutraceutical traits of *Artocarpus altilis*(Parkinson) Fosberg by characterizing its main bioactive compounds, nutritional traits, and antioxidant properties in order to contribute to the development of traditional and innovative uses of this species as functional food"."This anti-inflammatory *activity between fermented and natural-dried breadfruit leaves extract were compared" by Riasari et al.* [18]. Fermented and dried breadfruit leaves were extracted with soxhlet devise using methanol solvent.

"Antioxident, totalphenoliccontent and FTIR analysis of breadfruit methanolic leaves extract, which are essential in management of diabetes was demonstrated" by Leng *et al.* [19]. "Total phenolic content in fresh breadfruit leaves (144.16mg/g ± 17.98) was comparable to those of green tea.Acute toxicity, antiplasmodial and liver histopathological effects of aqueous extract of breadfruit leaves were explained" by Udonkany*et al.* [20]. The aqueous extract of breadfruit leaves has antiplasmodial properties and is safer at lower doses. The anxiety – like effects of breadfruit methanolic leaves extracts in Swiss mice was explained by Ajah *et al*. [21]. "Artocarpus altilis leaf extract was found to process antiolytic-like properties.The hepatoprotective effect of ethanolic extract of Indonesian breadfruit leaf in CCR_4 – induced liver

injury Wistar rats by measuring Serum Glutamic Pyruvic Transminase (SGPT) and malondialdehyde (MDA) level was examined" by Juliastuti*et al.* [22]. "Ethanol-based breadfruit leaf extract was found to have effect on liver protection by decreased level of MDA and SGPT.The chemical composition, functional, mineral and anti-nutritional properties of composite flour produced from breadfruit and beniseed was discussed" by Peters *et al*. [23]. "The 70:30 composite flour showed improved chemical composition and could be utilized for product development in different food system.A review on phytochemistry, bio-efficacy, medicinal and ethno-pharmaceutical importance of breadfruit was demonstrated" by Mohanty and Pradhan [24].

"The bioactive constituent and influence of ethanol concentration, time and temperature on the anti-oxidant and antibacterial activity of*Artocarpus altilis*leaves in order to find appropriate and effective condition for its extraction was investigated" by Saraswaty*et al.* [25].It was recommended to heat the extraction process to 70^0c in order to obtain both optimal antioxidant and antibacterial activity from ethanol extract of *Artocarpus altilis* leaves. Present work describes phytochemical analysis, antifungal and anti-bacterial screening of *Artocarpus altilis,*

Scientific Classification

Kingdom:	*Plantae*
Clade:	*Tracheophytes*
Clade:	*Angiosperms*
Clade:	*Eudicots*
Clade	*Rosids*
Order:	*Rosales*
Family:	*Moraceas*

Genus: *Artrocarpus*

Species: *Artocarpus altilis*

2.METHODOLOGY

2.1Collection of plant materials

The plant material leaves of *Artocarpus altilis* is collected from a yard on 5thStreet, UG Road, Turkeyen, Georgetown. Guyana.

2.2Preparation of plant materials:

The collected leaves sample of *Artocarpus altilis* is weighted on Citizen CTG 3000E electronic balance. The leaves dried in oven (Gallenhamp Incubator Model IH-150) at 50-55ºC. The dried leaves were cooled at room temperature and weighted again on same citizen electronic balance. Weight of green leaves, dried leaves and value of percentage moisture content in various samples of *Artocarpus altilis* is given in Table 1.

The weight of ground leaves of *Artocarpus altilis* is found to be 561.0 grams.

2.3Collection of test organism

Three (3) different microorganisms; *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans* were collected and used for the study. All tested organisms are referenced stains obtained from the Microbiology Laboratory of Georgetown Public Hospital Corporation, Georgetown (GHPC).All cultures were maintained in nutrient broth (Himedia, M002) at 37 °C and on nutrient agar (Himedia, MM012) slants at 4 °C.

2..4Extraction and preparation of test solutions

The ground leaves of *Artocarpus altilis* was extracted using different solvents; acetone, ethanol and methanol at a proportion of 1 in 10 dilution. Twenty (20) g of dried pulverized leaves was soaked in 200 mL of the corresponding solvent for 48 h. Solvent was decanted and the residue was again soaked in the same solvent to achieve a complete extraction of the bioactive components for 24 h. The total extract was combined and filtered. The evaporation of filtrate was done in rotavapour (Buchi). The respective solvent was added to viscous semi solid to liquid extract to make up the desired volume of extract solution.

*3.5Anti-Microbial Assay***:**

2.5.1 Materials

Mueller Hinton Agar (MHA), agar plates and microbial discs were purchased from the Caribbean medicals, Parika in Guyana. Solvents such as acetone, ethanol, and methanol were obtained from Aldrich. Scintillation vials (20 mL) were obtained from Meditron Scientific Sales, Georgetown, Guyana.

2.5.2 *Aseptic chamber*

Aseptic chamber consist of a wooden box of L = 1 meter, B = 1 meter and D = 0.5 meter area. Chamber is cleaned with 70 % ethanol twice and irradiated with short wave UV light for 1 h.

2.5.3 Potato Dextrose *Agar (PDA) medium*

Potato DextroseAgar medium prepared according to method reported by Talaro [26]. “This is the medium on which cultured bacteria Escherichia coli and Staphylococcus aureus were

grown. The 200 g potato was peeled finely chopped and boiled to a mash in distilled water, Each12.5 g dextrose and 12.5 g Agar was placed in a 1 L measuring cylinder. Distilled water was added to make the solution to 500 mL. The content was stirred until the consistency of solution mixture. The stirred mixture poured into conical flasks, plugged with cotton wool and tightly wrapped by aluminum foil. The flasks were autoclaved at 121 ºC, 15 psi, for 15 minutes" [26].

2.5.4 *Mother plates*

Mother plates were prepared by pouring potato dextroseAgar mixture into Petri dishes and to cool at room temperature, in the aseptic chamber.

2.5.5 Antimicrobial assay:

Antimicrobial assay was done by well diffusion method, poison plate method, paper disc method and streak plate methods. Which are as follows:

2.5.5.1**Well diffusion method:**

In this method well are made using a sterilized the cork borer on the seeded nutrient agar in a petri dish to which the test compound (leaves extract) of different concentration (25, 50, 75, 100, 125 µL s) are added. The treated petri discs are incubated at room temperature for 24 hrs. The inhibition zone formed around each well indicates the antibacterial activity. The procedure was repeated in duplicate and inhibitory zone was measured by ruler in mm [27].

2.5.5.2 **Poison plate method:**

The test organism (S. aureus, E. coli, C. albicans) seeded into nutrient medium were poured into petri discs and allow to cool and solidify. A 9 cm sterile cork borer was used to make a disk on pathogen plate. Pathogen disc was taken from pathogen plate and kept at the center of test compound (leaves extract of 25, 50, 75, 100, 125 µL concentrations) seeded plate with the help of a sterile inoculum needle

and was incubated for 2 to 3 days. The inoculum needle was sterilized with the alcohol and flame before each application. The experiment was done in duplicate and zone of inhibition was measured [28].

2.5.5.3 **Paper disc plate method:**

The circular discs of 6 mm diameter were prepared from whatman no.1 filter paper and sterilized iaa autoclave. These paper discs were impregnated with test compounds (leaves extract 25, 50, 75, 100, 125 µLs) in respective solvent (acetone, ethanol, methanol) for overnight and placed on nutrient agar plates seeded with test organism *(S. aureus , E. coli, C.albicans*) . The plates are incubated at room temperature for 12 hr. After 12 h zone of inhibition around each disc was measured by horizontal and vertical method and the diameter was recorded. A reference control was prepared using only the several (acetone , ethanol, methanol) and kept for comparison . The test done in duplicate to ensure the reliability of the results [29].

2.5.5. 4 **Streak plate method:**

The molten agar medium (20 m L) and each leaves extract and each leave extract (25, 50, 75, 100, 125 µL) was poured into a sterile petri dish under aseptic condition. It was cooled at room temperature. After cooling each bacterial culture was taken at 12, 24, 36 hrs. intervals and using the surface of agar medium in the form of parallel strokes (streaks). The test repeated in duplicates. The plates were incubated at room temperature for 24 hours and inhibitory zone was measured. Control plates without the plant extract were also maintained for the reference [30].

2.6Phytochemical analysis of the plant extracts

2.6.1Materials

Glacial acetic acid, thyonil chloride, dichloromethane, copper sulfate, lead acetate, diethyl ether, ferric chloride, acetic anhydride, antimony chloride, amyl chloride etc. obtained from Aldrich.

2.6.2Method

Phytochemical analysis of all the aqueous plant extracts was carried out by suitable methodologies in search of active ingredient responsible for antimicrobial toxicity.

The phytochemicals include under study were saponins, terpenoids, alkaloid, cardiac glycoside, phenol, steroidphytosteroid, tannins, phlobatanninsand flavonoids the analysis was carried outaccording to the methodologies of Edeoga*et al.* [31].

Table 1: PERCENTAGE MOISTURE CONTENT FOR *ARTOCARPUS ALTILIS* LEAVES

(Oven temperature 50 – 55 ^{0} C)

Sample Number	Weight of green leaves (gram)	Weight of dry leaves at 10 am(grams)	Weight of dry leaves at 4 pm (grams)	Percentage moisture content %
1	283	96	96	66.07
2	438	128.5	128.5	70.66
3	389	115	115	70.44
4	409	125	125	69.44
5	370	127.5	127.5	65.254

$$\text{Percentage moisture content} = \frac{\text{Weight of green leaves} - \text{weight of dry leaves}}{\text{weight of green leaves}} \times 100$$

3.RESULTS

3.1 Well diffusion method

Antimicrobial activity of *Artocarpus altilis* leaves extract against *E coli, S. aureus and C. albicans* are summarized in **Tables 2-4** by well diffusion methods.

Table 2. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *E. coli*.

Compared with control by well diffusion method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.10	0.16	0.20
	50	0.25	0.20	0.25
	75	0.30	0.26	0.30
	100	0.35	0.30	0.35
	125	0.35	0.32	0.39

- Duplicate

Table 3. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *S. aureus*.

compared with control by well diffusion method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.21	0.22	0.28
	50	0.25	0.25	0.29
	75	0.35	0.30	0.30
	100	0.38	0.32	0.33
	125	0.42	0.34	0.35

*Duplicate

Table 4. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *C. albicans*.

Compared with control by well diffusion method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.15	0.21	0.25
	50	0.20	0.25	0.29
	75	0.25	0.29	0.30
	100	0.30	0.32	0.42
	125	0.35	0.35	0.49

* Duplicate

3.2 **Poison plate method**

Antimicrobial activity of *Artocarpus altilis* leaves extract against *E coli, S. aureus and C. albicans* are summarized in **Tables 5 -7** by poison plate methods.

Table 5. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *E. coli.*

Compared with control by poison plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.22	0.20	0.25
	50	0.31	0.22	0.27
	75	0.32	0.26	0.29
	100	0.44	0.30	0.33
	125	0.50	0.33	0.34

*duplicate

Table 6. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *S. aureus.*

Compared with control by poison plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.19	0.28	0.29
	50	0.22	0.32	0.30
	75	0.26	0.33	0.32
	100	0.28	0.45	0.34
	125	0.30	0.52	0.35

*duplicate

Table 7. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *C. albicans.*

Compared with control by poison plate method.

Plant	Leaves extract	Diameter of the inhibitory (mm)*

	solvent (µL)	Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.18	0.24	0.33
	50	0.20	0.25	0.34
	75	0.22	0.26	0.35
	100	0.24	0.28	0.46
	125	0.26	0.29	0.53

*duplicate

3.3 Paper disc method

Antimicrobial activity of *Artocarpus altilis* leaves extract against *E coli, S. aureus and C. albicans* are summarized in **Tables 8-10** by paper disc plate methods.

Table 8 Antimicrobial activity of crude leaves extracts of Artocarpus altilis in various solvents against *E. coli.*

Compared with control by paper disc plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.22	0.23	0.24
	50	0.31	0.25	0.25
	75	0.32	0.27	0.38
	100	0.44	0.29	0.30
	125	0.51	0.30	0.32

*duplicate

Table 9. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *S. aureus.*

Compared with control by paper disc plate method.

Plant	Leaves extract	Diameter of the inhibitory (mm)*

	solvent (µL)	Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.15	0.26	0.23
	50	0.17	0.28	0.25
	75	0.19	0.29	0.28
	100	0.20	0.41	0.30
	125	0.21	0.48	0.33

*duplicate

Table 10. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *C. albicans*.

Compared with control by paper disc plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.15	0.21	0.27
	50	0.30	0.25	0.31
	75	0.35	0.28	0.32
	100	0. 39	0.30	0.45
	125	0.35	0.34	0.51

*duplicate

3.4 Streak plate method

Antimicrobial activity of *Artocarpus altilis* leaves extract against *E coli, S. aureus and C. albicans* are summarized in **Tables 11-13** by Streak plate methods.

Table 11. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *E. coli*.

Compared with control by streak plate method.

Plant	Leaves extract	Diameter of the inhibitory (mm)*

	solvent (µL)	Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.16	0.20	0.23
	50	0.18	0.22	0.24
	75	0.19	0.25	0.26
	100	0.20	0.27	0.28
	125	0.24	0.29	0.30

*duplicate

Table 12. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *S. aureus*.

Compared with control by Streak plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.16	0.18	0.20
	50	0.17	0.19	0.22
	75	0.19	0.21	0.24
	100	0.21	0.23	0.29
	125	0.23	0.25	0.31

*duplicate

Table 13. Antimicrobial activity of crude leaves extracts of *Artocarpus altilis* in various solvents against *C. albicans.*

Compared with control by Streak plate method.

Plant	Leaves extract	Diameter of the inhibitory (mm)*

	solvent (µL)	Acetone	Ethanol	Methanol
Artocarpus altilis (Breadfruit)	25 control	0	0	0
	25	0.20	0.22	0.23
	50	0.22	0.25	0.26
	75	0.25	0.29	0.29
	100	0.29	0.33	0.31
	125	0.31	0.35	0.36

*duplicate

3.5 Phytochemical analysis:

Phytochemical analysis **Table 14** of the *Artocarpus altilis* (*breadfruit*) leaves extracts revealed the presence of tannins, saponins, flavonoids, alkaloids, cardiac glycosides, terpenoids, phenol, phlobatannins, steroids and phytosteroids.

Table 14 :Phytochemical analysis breadfruit *Artocarpus altilis* leaves extracts

S. No.	Phytoconstituents	
1	Tannins	Absent
2	Saponins	Absent
3	Flavonoids	Present
4	Alkaloids	Absent
5	Cardiac glycosides	Absent
6	Terpenoids	Present
7	Phenol	Present
8	Steroids and phytosteroids	Present
9	Steroids and phytosteroids	Present

4. DISCUSSION

It is observed from **Tables 2-4** thatin acetone solvent maximum (0.42 mm: 125 µL) inhibitory zone was observed for *S. aureus* and minimum inhibitory zone (0.10 mm: 25 µL) was observed for *E.coli*.In ethanol solvent maximum (0.35 mm: 125 µL) inhibitory zone was observed for *C.*

*albican*and minimum inhibitory zone (0.16 mm: 25 µL) was observed for *E.coli.*In methanol solvent maximum (0.49 mm: 125 µL) inhibitory zone was observed for *C. albicans* and minimum inhibitory zone (0.20 mm: 25 µL) was observed for *E.coli.*

It is clear from **Tables 5-7** that in acetone solvent maximum (0.50 mm: 125 µL) inhibitory zone was observed for *E. coli* and minimum inhibitory zone (0.18 mm: 25 µL) was observed for *C. albicans*.In ethanol solvent maximum (0.52 mm: 125 µL) inhibitory zone was observed for *S. aureus* and minimum inhibitory zone (0.20 mm: 25 µL) was observed for E. coli.In methanol solvent maximum (0.53 mm: 125 µL) inhibitory zone was observed for *C. albicans* and minimum inhibitory zone (0.25 mm: 25 µL) was observed for *E. coli.*

It is seen from **Tables 9-10** thatin acetone solvent maximum (0.51 mm: 125 µL) inhibitory zone was observed for *E. coli* and equal (0.15 mm: 25 µL) inhibitory zone was observed for *S. aureus* and *C. albicans*.In ethanol solvent maximum (0.48 mm: 125 µL) inhibitory zone was observed for *S. aureus* and minimum inhibitory zone (0.21 mm: 25 µL) was observed for *C. albicans*.In methanol solvent maximum (0.51 mm: 125 µL) inhibitory zone was observed for *C. albicans* and minimum inhibitory zone (0.23 mm: 25 µL) was observed for *S. aureus.*

The**Tables 11-13** indicated thatin acetone solvent maximum (0.31 mm: 125 µL) inhibitory zone was observed for*C. albicans* and equal (0.16 mm: 25 µL) inhibitory zone was observed for *E. coli* and *S. aureus*.In ethanol solvent maximum (0.35 mm: 125 µL) inhibitory zone was observed for *C. albicans* and minimum inhibitory zone (0.18 mm: 25 µL) was observed for *S. aureus.*In methanol solvent maximum (0.36 mm: 125 µL) inhibitory zone was observed for *C. albicans* and minimum inhibitory zone (0.20 mm: 25 µL) was observed for *S. aureus.*

In general it is clear from **Tables 2-13** that inhibitory zone follow the order: Methanol > ethanol >acetone in most of the assay studies. This may due to high polarity of methanol solvent.In most of the essay studies inhibitory zones among the methods follow the order well diffusion method > poison plate method > paper disc method > streak plate method.It is seen from **Tables 2-13** that inhibitory zone or antimicrobial potential increases as the amount of leaves extract increases from 25 µL to 125 µL. this may be due to increase in amount of extracts. It is clear from **Tables 2-13** that all plant extract showed antimicrobial potential activity toward the gram positive bacteria staphylococcus aureus also gram negative bacteria *Escherichia coli*and fungus*C. albicans.*

The phytochemical analysis of methanol leaves extract of *Artocarpus altilis* (**Table 14**) tested positive for flavonoids, terpenoids, phenol, phlobatannins, steroids and phytosteroids, and negative for tannins, saponins, alkaloids and cardiac glycosides. Medical benefits of *Breadfruit* extracts include, cardiovascular health, good for skin, reduce diabetes, dental health, energy booster, bone health, sleep better at night, resistance against infection etc. The wood of Breadfruits one of the most valuable timbers in the construction of traditional houses. *Breadfruit* contains phytochemicals having potential as an insect repellent.

List 1: Breadfruit (*Artocarpus altilis*), Nutritive Value per 100 g. (Source: USDA National Nutrient data base) are as follow

Principle	Nutrient Value	Percentage of RDA
Energy	103 Kcal	5%
Carbohydrates	27.12 g	21%
Protein	1.07 g	2%
Total Fat	0.20 g	1%
Cholesterol	0 mg	0%
Dietary Fiber	4.9 g	13%

Vitamins

Folates	14 µg	3.5%
Niacin	0.900 mg	6%
Pyridoxine	0.100 mg	8%
Riboflavin	0.030 mg	2%
Thiamin	0.110 mg	9%
Vitamin A	0 IU	0%

Vitamin C	29 mg	48%
Vitamin E	0.10 mg	1%
Vitamin K	0.5& mug	<1%

Electrolytes

Sodium	2 mg	0%
Potassium	490 mg	10.5%

Minerals

Calcium	17mg	2%
Copper	0.084 mg	9%
Iron	0.54 mg	7%
Magnesium	25 mg	6%
Manganese	0.060 mg	2.5%
Phosphorus	30 mg	4%
Selenium	0.6µg	1%
Zinc	0.12 mg	1%

Photo-nutrients

Carotene-B	0µg	--
Crypto-xanthin-B	0µg	--
Lutein-zeaxanthin	22µg	--

Medical benefits include, cardiovascular health, good for skin, reduced diabetes, dental health, energy booster, bone health, sleep better at night, resistance against infections, etc.

The wood of the *breadfruit* was one of the most valuable timbers in the construction of traditional houses in Samoan architecture.The part of fruit that are discarded can be used to feed livestock. The leaves of the *breadfruit* trees can also browse by cattle.

The parallel studies in phytochemical analysis and antibacterial screening of *Artocarpus altilis* has been reported in chemical literature. Fitrya*et al.* [32] has evaluated the diuretic effects of the ethyl acetate fraction of *Artocarpus* champeden, *Artocarpus altilis and Artocarpus heterophyllum, leaves in normotensive Wistar rats*. The use of some plant leaves as natural preservative for wrapping food and protecting food against oxidation and foodborne pathogens through their antioxidant and antimicrobial activities been described by Thongphichai*et al.* [33]. Mehta *et al.* [34] has provided a comprehensive review on various processing methods of flour and starch, nutritional significance and new food applications of *Breadfruit.* Determination of antibacterial and antioxidant activities, total flavonoid and total phenolic content of *Artocarpus altilis*ethanol leaves extract has been studied by Effendy *et al.* [35]. The polyphenolic content, *the antioxidant and antifungal properties of Jackfruit extract on phytopathogenic fungiPenicillamine digitatum, Geotricumcandidum, Botrytis cinerea* has been investigated by Chavez- Santiago et al. [36]. Soifoini*et al.* [37] has evaluated the health – promoting potential of Breadfruit, a traditional Comorian food.The antifungal property of *Artocarpus altilis*against *Aspergillus niger* causing black molds in onion has been investigated by Zurbano [38]. Ahmad *et al*. [39] has investigated that *Artocarpus altilis*leaves exhibited biological properties that suggested its use as a new source of natural antioxidant and antimicrobial. Based on Molecular docking study, non-covalent interactions are the main interaction occurring between the major bioactive compounds and bacteria.

5. CONCLUSION

It is found from present studies that inhibitory zone or antimicrobial potential of leaves extract increases as their amount increases.In general, among four methods used for antimicrobial studies well diffusion method and streak plate methods were found to have highest and lowest inhibitory zone, respectively.In most of the essay studies maximum and minimum antimicrobial potential was observed for methanol and acetone solvent extract, respectively.The phytochemical flavonoids, terpenoids, phenol, phlobatannins, steroids and phytosteroids are found to present in methanol leaves attract of *Artocarpus altilis*.The phytochemicals tannins, saponins, alkaloids and c*ardiac glycosides are found to be absent in methanol leaves attract of Artocarpus altilis (breadfruit*).It is observed from the present studies that leaves extract of *Artocarpus altilis* have antimicrobial property and its potential increases as their amount increases.Present research work is very useful for the researchers of similar research interest.

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REFERENCES

1. Smith M, Elizabeth A, "Tracking Austronesian expansion into the pacific via the paper mulberry Plant", *Proceedings of the national Academy of Sciences,*2015; 112 (44): 13432 – 13433.
2. Zerega NJC, Rogone D,Moteley J J, "The complex origins of breadfruit (*Artocarpus altilis*), moraceae: Implications for human migration in oceanic", *American Journal of Botany,* 2004; 91(5) : 760 – 766.
3. Morton JF, "Breadfruit: In fruits of warm climates", New Crop, the New Crop Resource Online Program, Center for New Crops and Plant Products, Department of Horticulture and Landscape Architecture, Purdue University, In., 1987, pp. 50 – 58.
4. Jones MP, Klun JA, CantrellCL , Ragone D , Murch SJ, "Isolation and identification of mosquito (*Aedes aegypti*). Biting DetlerentFatty Acids from Male Inflorescences of Breadfruit (*Artocarpus altilis* (Parkinson) Fasberg" *Journal of Agricultural and Food Chemistry*, 2012; 60 (15):3868 – 3873.
5. Sivagnanasundaram P, Karunanayake KLC, "*Phytochemical screening and antimicrobial activity of Artocarpus heterophyllus and Artocarpus altilis* leaf and stem bark extracts", *OUSL Journal*, 2015; 9; 1 – 17.
6. Luzuriaga-Quichimbo CX, Blanca-Salas J, Caron-Martinez CE, Ruiz-Tellez T, "Providing added value to local uses of Paparahua (*Artocarpus altilis*) in amazonianequadore by phytochemical data review", *Revista Brasileira de Farmacognosia*, 2019; 29 : 62 – 68.
7. Riasari H, Ulfah M, PrayugoD, Komariah NA , Antibacterial and antifungal activities of various breadfruit leaves (*Artocarpus altilis* (Parkinson) Fosberg*), International Journal of Pharmceutical Sciences and Research, 2017;* 2 (13) : 1066 – 1073.

8. Pradhau C, Mohanty M, Ront A, "Phytochemical screening and comparative bioefficacy assessment of *Artocarpus altilis* leaf extracts for antimicrobial activity". *Frontiers in Life Science,* 2012; 6 (3-4): 71 – 76.
9. Mbaeyi-Nwaoha IF, Onwuka CP, Comparative evaluation of antimicrobial properties and phytochemical composition of *Artocarpus altilis* leaves using ethanol, n-hexane and water, *African Journal of Microbiology Research,* 2014; 8 (37): 3409– 3421.
10. Palaps DKS, RetnonigrumDS, IwoMI,Soemardji AA, Leaf extract of Artocarpus altilis [Park] has potential as anti-inflammatory antioxidant and immunosuppressant. *Rasayan Journal of Chemistry, 2020;* 13 (1): 636 – 646.
11. Gladys FF, Bukola KE, Larvicidal activity of *Artocarpus altilis* against culex Quinquefasciatus, *International Journal of Plant Studies,*2019;2 (1) :1 – 4.
12. Nisa K,Apriyana W, Rosyida VT, Antimicrobial activity of Indonesian plant extracts against food borne microorganisms, *Asian J. Agric. Biol.,*2019; 7 (2) : 300– 306.
13. NocheraCL, Ragone D, "Development of a breadfruit flour pasta product" *Foods, 2019;* 8 (110): 1– 8.
14. RanteH, Alan A, Irwan M. , ∝- Glycosidase inhibitory activity of breadfruit leaf extract (*Artocarpus altilis*(Parkinson) Fosberg). *The 3rd International Conference on Science, Journal of Physics: Conference Series,* 2019; 1341: 1– 9.
15. Nayagam V, PalamsamyK ,Thiraviadoss D, "Cyto-toxicity and oligogynamic effect of bio-synthesized silver nanoparticles from plant residue of Artocarpus altilis and its spectroscopic analysis" *Asian Journal of Nanoscience and Materials,*2019; 2 : 301 – 313.
16. Marta H, Cohaya Y, Arifin MR,Khairani L, "Comparing the effects of four different thermal modifications on physicochemical and pasting properties of breadfruit

(*Artocarpus altilis*) starch, *International Food Research Journal*, 2019; 26 (1): 269 – 276.

17. SoifoiniT, Donno D, Jeannoda V, Rakotoniaina E, Hamidou S,Achmet M, Solo NR, Afraitane K, Giacoma C,Beccaro GL , "Bioactive compounds, nutritional traits and antioxidant properties of *Artocarpus altilis* (Parkinson) fruits: Exploiting a potential functional food for good security on the Comoros Islands, *Hindawi, Journal of Food Security*, 2018; 2018:1 – 11. (Article ID 569792 B).
18. Riasari H,Fitriansyah SN, Putra O, "Comparison of anti-inflammatory activity between fermented and dried breadfruit leaves extract (*Artocarpus altilis*)", *Pharmacology and Clinical PharmacyResearch,*2018; 3 (3): 72 –75.
19. Leng LY, Nadzri NB, K. C. ShaariKC , Antioxidant and total phenolic content of breadfruit (Artocarpus altilis) leaves, *MATEC Web of Conferences*, 2018; 150: 1 – 4.
20. Vdonkany ML, Eluwa MA,Enun BK, Inyang-Etoh PC, Inyang IT, "Studies of antimalarial activity and liver histopathological changes of *Artocarpus altilis* on Plasmodium berghei-infected mice" *Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences*, 2018; PP 106 – 114.
21. Ajah AA, Onasanwo SA, Aitokhuehi NG, Faborode OS, Anxiolytic potentials of Artocarpus altilis (breadfruit) in Swiss mice, *Ann Depress Anxiety*, 2017; 4 (2) :1089 – 1092.
22. Juliastuti H, Navianti AT, Fatawi BA,Yuslianti ER, "Ethanol-based breadfruit leaf (Artocarpus altilis) extract as hepatoprotective in carbon tetrachloride-induced liver injury", *J. Pharmacol. Toxicol.*, 2017; 12 (3) : 136 – 141.

23. Peters H, Gloria FN, Ikpome CE,Akinkunmi YM, "Nutritional evaluation of breadfruit and beniseed composite flours", *MOJ Food Processing & Technology*,2016; 2 (6) : 194 – 199.

24. Mohanty M, Pradhan C, A review on phytochemistry, bio-efficacy, medicinal importance of *Artocarpus altilis*, *International Journal of Pharmacy and Pharmaceutical Research*,2015; 3 (1): 219 – 231.

25. Saraswaty V, RisdianC, Lelone RAA, Mozef T, "Influence of ethanol concentration and temperature on antioxidant and antibacterial activity from *Artocarpus altilis* (Parkinson) Fosberg leaves" *Oxid Antioxid Med Sci*.,2015; 4 (2):97 – 109.

26. Talaro KP, Foundation in microbiology, Wm. C. Brown Publisher, USA, 1993.

27. Perez C, Pauli M,Bazerque P, An antibiotic assay by the agar well diffusion method, *Acta Biological et Medicine Experiments*, 1990; 15: 113-115.

28. Murray PR, Barron EJ,Pfuller MA,Tenover FC, YolkeRH.*Mannual ofClinical Microbiology*, 6th edition. Mosby Year Book, London 1995.

29. Marujella JC Henry PA, Antimicrobial activity of perfume oil, *Journal of American Pharmaceutical Association*,1958; 28: 471- 478.

30. Orzechowski G , Antibiotica in loheren pflanzen , *Pharmazie in Unser Zeitt* , 1972; 1: 42-53.

31. Edioga HO, Okwu DE,Mbalble RO, Phytochemical constituents of some Nigerian medicinal Plants, Afr. *J. Biotechnol.* , 2005; 4 (7) : 685 – 688.

32. Fitrya, Amriyani A. Novita RP, Gabriella R, Lestari SV, Agustina A. The diuretic effect of ethyl acetate fractions of *Artocarpus altilis*, *Artocarpus champeden*, and *Artocarpus*

heterophyllus leaves in normotensive Wistar rats, *Journal of Ayurveda and Integrated Medicine*, 2023; 14: 10046(1-6).

33. Thongphichai W, Pongkittiphan V, Laorpaksa A, Wiwatcharakomkul W, Sukrong S, Antimicrobial activity against foodborne pathogens and antioxidant activity of plant leaves traditionally used as food packaging,*Foods*, 2023; 12: 2409(1-16).
34. Mehta KA, Quek YCR, Henry CJ, Breadfruit (Artocarpusaltilis): Processing, nutritional quality and food applications,*Frontiers in Nutrition*, 2023; 10: 1156155(155).
35. Effendy DL, Mahatir M, Denny S, Nasri, Antibacterial and antioxidant activities of ethanol extract of *Artocarpus altilis*, *Food Research*, 2023; 7(3): 148-152.
36. Chavez – Santiago, Rodriguez- Castellanos GC, Montenegro G, Bridi R, Valdes- Gomez H, Alvarado-Reyna S, Castillo-Ruiz O, Santiago-Adam R, Phenolic content, antioxidant and antifungal activity of Jackfruit extract (*Artocarpus heterophyllus Lam*) , Food Science Technology, Campinas, 2022; 42: e02227 (1-7).
37. Soifoini T, Donno D, Jeannoda V, Rakoto DD, Msahazi A, Farhat SMM, Oulam, MZ, Beccaro GL, Phytochemical composition, antibacterial activity and antioxidant properties of the*Artocarpus altilis* fruits to promote their consumption in the Comoros Islands as potential health promoting food or a source of bioactive molecules for the food industry,*Foods*, 2021; 10: 2136(1-22).
38. Zurbano LY, Antifungal activity of Breadfruit extract against *Aspergillusniger* causing black molds in onion. *Journal of Jilian University (Engineering and Technology Edition*) 2021; 40(6): 1-12.

39. Ahmad MN, Karim MU, Normaya E, Piah BM, Iqbal A, Bulat KHK, *Artocarpus altilis*, extracts as a food borne pathogen and oxidation inhibitors:RSM COSMORUS and molecular docking approached, *Scientific Report, Nature Search*, 2020; 10: 9566 (1-14).