Phytochemical Analysis and Antimicrobial Screening of *Artocarpusaltilis*: Guyana Flora Extracts

ABSTRACT

The plant material leaves of *Artocarpusaltilis* (Breadfruit) were collected from university of Guyana road, Cummings lodge, Guyana. Leaves weredried 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 *Artocarpusaltilis*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: *Artocarpusaltilis*; 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 contains phytochemicals having potential as an insect repellent [4].SivagnanaSundaram and Karunanayeke [5] has investigated phytochemical screening and antimicrobial activity of Artocarpusheterophyllus and Artocarpusaltilis leaf and stem hexane, dichloromethane and ethanol extracts. The local uses of paparahua (Artocarpusaltilis) in Amazonia Ecquadore by 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 *Artocarpusaltilis* 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 *Artocarpusaltilis.* 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 (Artocarpusaltilis [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 culexquinquefasciatus mosquito.Nisa et al. [12] has evaluated antifungal and antibacterial activity of ethanolic and distilled water extracts of *Artocarpusaltilis*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.Rante et al.[14] has studied $\propto$- glycosidase inhibitory activities of n- hexane and ethanolic, yellow and green breadfruit leaves extract ethanolic leaf extracts were found to have more $\propto$-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 *Artocarpusaltilis*(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]. Artocarpusaltilis 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*Artocarpusaltilis*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 Artocarpusaltilis leaves. Present work describes phytochemical analysis, antifungal and anti-bacterial screening of Artocarpusaltilis,

Scientific Classification

Kingdom:	*Plantae*
Clade:	*Tracheophytes*
Clade:	*Angiosperms*
Clade:	*Eudicots*
Clade	*Rosids*
Order:	*Rosales*
Family:	*Moraceas*
Genus:	*Artrocarpus*
Species:	*Artocarpusaltilis*

2.METHODOLOGY

2.1Collection of plant materials

The plant material leaves of Artocarpusaltilis is collected from a yard on 5^{th}Street, UG Road, Turkeyen, Georgetown. Guyana.

2.2Preparation of plant materials:

The collected leaves sample of Artocarpusaltilis 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 Artocarpusaltilis is given in Table 1.

The weight of ground leaves of Artocarpusaltilis 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 *Artocarpusaltilis* 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, Each 12.5 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.

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 was prepared from whatman no.1 filter paper and sterilized ia a 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 the each bacterial culture was taken at 12, 24, 36 hour 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 Artocarpusaltilis 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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis 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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis in various solvents against C. albicans.

Compared with control by poison plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpusaltilis (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 Artocarpusaltilis 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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis in various solvents against S. aureus.

Compared with control by paper disc plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpusaltilis (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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis 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 Artocarpusaltilis in various solvents against E. coli.

Compared with control by streak plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpusaltilis (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 Artocarpusaltilis 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
Artocarpusaltilis (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 Artocarpusaltilis in various solvents against C. albicans.

Compared with control by Streak plate method.

Plant	Leaves extract solvent (µL)	Diameter of the inhibitory (mm)*		
		Acetone	Ethanol	Methanol
Artocarpusaltilis (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 Artocarpusaltilis (breadfruit) leaves extracts revealed the presence of tannins, saponins, flavonoids, alkaloids, cardiac glycosides, terpenoids, phenol, phlobatannins, steroids and phytosteroids.

Table 14 :Phytochemical analysis breadfruit Artocarpusaltilis 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** that (i)In 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. (ii) 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.(iii) 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 (i) 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. (ii) 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. (iii) 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** that (i) In 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. (ii) 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. (iii) 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 that (i) In 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. (ii) 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. (iii) 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 (i) inhibitory zone follow the order :Methanol > ethanol > acetone in most of the assay studies. This may due to high polarity of methanol solvent. (ii) 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. (iii) 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. (iv) 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 Artocarpusaltilis (**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 (Artocarpusaltilis), 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. Breadfruit tree with fruit and leaves is shown in Figure 1.

5. CONCLUDING REMARKS

(i) It is found from present studies that inhibitory zone or antimicrobial potential of leaves extract increases as their amount increases.

(ii) 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.

(iii) In most of the essay studies maximum and minimum antimicrobial potential was observed for methanol and acetone solvent extract, respectively.

(i) The phytochemical flavonoids, terpenoids, phenol, phlobatannins, steroids and phytosteroids are found to present in methanol leaves attract of Artocarpusaltilis.

(ii) The phytochemicals tannins, saponins, alkaloids and cardiac glycosides are found to be absent in methanol leaves attract of Artocarpusaltilis (breadfruit).

(iii) It is observed from the present studies that leaves extract of Artocarpusaltilis have antimicrobial property and its potential increases as their amount increases.

(iv) Present research work is very useful for the researchers of similar research interest.

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Conference name: 4th Edition ofCHEMISTRY WORLD CONFERENCE

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Figure 1. Breadfruit tree with leaves and fruits