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Evaluation of Cytotoxic and Anti-microbial Activities of the Methanolic Leaf Extracts of *Sansevieria zeylanica* (L.) Willd. Against the Human Breast Cancer, MDA-MB-231 Cell Lines

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Abstract

Sansevieria zeylanica is a species of xerophytic perennial herbs with a wide range of distribution found in dry tropical and subtropical parts of the world. It is a wonderful medicinal plant and holds the widespread range of beneficial properties. The aim of the study is to determine the cytotoxic activities of the human breast cancer - MDA-MB-231 cell lines and to evaluate the anti-microbial activities by employing the methanolic leaf extracts of *S. zeylanica* plants. The main experiment was to determine the susceptibility of a microbial organisms against the methanolic leaf extracts of *S. zeylanica*. The percentage growth inhibition was calculated and concentration of sample to inhibit cell growth by 50 % (IC50) values was generated for the percentage viability. The leaf extracts produced from *S. zeylanica* plants showed a cytotoxic effect against the human breast cancer - MDA-MB-231 cell lines. The IC50 value of 1167.78 µg/ ml was obtained for the MDA-MB-231 cell lines after the exposure of 24 h treatment. The increase in cell death of MDA-MB-231 cell lines with an increase in the concentration indicates that the methanolic leaf extract of *S. zeylanica* plants was found active. For the first time, we made an attempt to examine the biological properties of methanolic leaf extracts from *S. zeylanica* plants with reference to their wide applications. The results obtained support for the therapeutic applications and this acts as an anti-microbial agent. These studies showed the results from the phytochemical screening, anti-microbial and cytotoxic activities of S. zeylanica indicating that this plant as a "natural herbal source". This can be used for its pharmaceutical and pharmacological applications in a large-scale industry.

Keywords: Anti-microbial activity, Cytotoxic effect, MDA-MB-231 cell lines, Methanolic leaf extract.

INTRODUCTION

Sansevieria zeylanica (L.) Willd. (Asparagaceae) is a plant local animal types to beach front spaces of India and Sri Lanka, the islands of the Indian Ocean, Africa, and Oriental India. It is a type of xerophytic species with a wide scope of dispersion found in dry tropical and subtropical areas of the planet (Newton, 2018). *Sansevieria zeylanica* is a herbaceous plant with delicious, inflexible, sunken or wrinkled leaves, blotched and mottled with dark, 4-5 ft. height; particularly found in dry or rough soil at low heights. Yet in addition, it blossoms in a soggy environment up to 2,000 ft. or then again higher, and is effortlessly multiplied through seed, suckers or leaf-cuttings (Newton, 2018).

The morphological, physical, chemical, mechanical, and thermal properties of a fibers extracted from the *S. zeylanica* plant leaves by decortication process and it emerges as potential support for its composite structures due to the presence of mechanical and ribbon fibers. This fiber consists of primary cell wall, secondary cell wall, fiber lumen and middle lamellae (Krishnan and Rajadurai, 2016).

The medicinal practices of *S. zeylanica* plants includes mainly for the treatment of abdominal pains, ear ache, diarrhea and hemorrhoids. According to the Vysakh and Babu (2015), the warm juice of this plant leaves was dropped in to the ear as a treatment for earache. The juices of fresh leaves are used to treat pharyngitis and harshness. The leaf sap was applied directly to the infected sores, cuts and grazes; and also used for the treatment of fungal and scabies infection.

Currently, plant materials such as extractions from roots, stems, leaves, flowers and seeds are developing as promising agents for the treatment of different cancers. The anticancer and antimicrobial activities of methanolic plant extracts have been evaluated against a variety of human cancer cell lines. However, very few reports are available against the breast cancer cells.

The MDA-MB-231 cell line is an epithelial, human breast cancer cell line and is one of the most commonly used in the medical research laboratories. This is regarded as invasive *in vitro* remain relatively poor in metastatic; but *in vivo*, this cell line has proved useful in models of experimental metastasis (Holliday and Speirs, 2011).

The present study was designed in a simple, cost-effective and eco-friendly manner to synthesize the methanolic leaf extracts of *S. zeylanica*. Based on their mode and mechanisms of action on microorganisms and cell lines, the experiments were carried out to gather the information on the methanolic leaf extracts of *S. zeylanica*.

The major objective of this study is to evaluate the cytotoxic and anti-microbial activities of methanolic leaf extracts obtained from the *S. zeylanica* plant against human breast cancer cell line. Our group has made an attempt to report for the first time on the bioorganic synthesis of methanolic leaf extracts from *S. zeylanica* plants and their widespread applications.

With such a goal line, an effort has been made to produce the methanolic extracts utilizing very commonly available natural products from the *S. zeylanica* plant leaves. The *S. zeylanica* plant leaves exhibit pharmacological, medicinal and mechanical properties owing to the presence of various phytochemical properties. The present study demonstrates the antibacterial and antimicrobial activities of the obtained methanolic leaf extracts against the microbial organisms such as *Escherichia coli* - ATCC 11775/ MCC 2079 (T), *Staphylococcus aureus* - ATCC 25923/ MCC 2408 and *Candida albicans* - ATCC10231. Further, the cytotoxic effects of methanolic leaf extracts from *S. zeylanica* plant were tested against the MDA-MB-231 cell lines by MTT assay. The present investigation unlocks a novel opening to practice this method of eco-friendly approach for the preparation and biological applications of *S. zeylanica* plant products.

MATERIALS AND METHODS

Collection of plant materials

The mature fresh leaves of *S. zeylanica* plants were collected from the hedgerows of the

agricultural fields (wild habitats) of the Mrs. Vasanth Ranganath Farm House, Thimmsandra Village, Kannmangala Post, Madurai Hobli, Doddaballapura Taluk, Bengaluru Rural District (13° 12¢ 30.71² N and 77° 25¢ 22.13² E with an elevation of 879.348 m asl), Karnataka, India during July 2020 (Fig. 1). The plant was identified and authenticated by the Late Dr. M. N. Shivakameshwari, Associate Professor, Department of Botany, Bangalore University, Bengaluru 560 056.

Fig. 1. Photographs showing the site of the *Sansevieria zeylanica* plant collections.

Preparation of plant extracts

The methanolic extraction method of *S. zeylanica* aerial leaves were carried out as described by Harwood and Moody (1989). All the glass apparatus was rinsed by methanol and dry it in the oven at 70 °C. Sixty grams of dried leaves of *S. zeylanica* was weighed, grounded and then solid material was placed in a filter paper holder and placed in an extractor, and the cleaned round bottom flask (500 ml) was filled with 400 ml of methanol. The whole setting was placed on a heating mantle and methanol was allowed to boil (boiling temperature 60-65 °C). The extraction process was carried out for several hours, almost six hours (until it becomes colorless). The condensing

unit was removed from extraction unit and allowed the sample to cool down. Almost, all the solvent was collected after distillation, and it was filtered through Whatman No.1 filter paper. Then sample was placed in the water-bath and dried. Further, the weight of the sample was measured. The methanolic leaf extractions of *S. zeylanica* was calculated using the formula:

$$\%\,\text{Yield} = \frac{\text{Dry extract weight}}{\text{Total sample weight}}\ \text{X}\ 100$$

The obtained extracts were dried to remove excess amount of solvents and stored at 4 °C for further studies.

Determination of phytochemicals profiling

The phytochemical profiling of obtained methanolic leaf extracts of *S. zeylanica* plants was carried out as prescribed by Harwood and Moody (1989), Harborne (1984), Trease and Evans (1996), and Haldar *et al.,* (2010a, 2010b). The screening was performed for the indication (whether present or absent) of phytochemicals through the analytical tests by color intensity or the precipitate formation. The results were qualitatively determined and expressed as positive '+' sign for the presence and negative '−' sign for the absence of phytochemicals (Philip *et al.*, 2011).

Anti-microbial activity

Antibacterial activity of the prepared methanolic leaf extracts of *S. zeylanica* plants was determined using agar well diffusion method (Dobrucka and Dugaszewska, 2016). Minimum inhibitory concentration (MICs) is the lowest concentration of a substances inhibiting the growth of a microorganism and expressed in mg/ mL. The main aim of the experiment was to determine the susceptibility of a microbial organisms against the methanolic leaf extracts of *S. zeylanica*.

The anti-microbials present in the plant extract are allowed to diffuse out into the medium and interact in a plate freshly seeded with the test organisms. The resulting zones of inhibition would be uniformly circular and the diameter of zone of inhibition can be measured in millimeters. The agar used was Meuller-Hinton agar for bacteria, Potato Dextrose agar for fungi and Yeast Peptone Glucose (YEDP) Agar for yeast that is rigorously tested for composition and pH. This method is well documented as the standard zones of inhibition have been determined for susceptible and resistant values.

Petri plates (with diameter of 90 mm) containing 20 mL Meuller-Hinton agar were seeded using cotton swab with 24 h (old) culture of the microbial strains. Wells were cut (10 mm diameter) and 50 µL of different concentrations of Test sample. The plates were then incubated at 37 °C for 24 h. The anti-microbial activity was analyzed by measuring the diameter of the inhibition zone formed around the well against the test microorganisms (Raj *et al.,* 2015; Rajashekara *et al.,* 2020). Three testing microorganisms such as *Escherichia coli* - ATCC 11775/ MCC 2079 (T), *Staphylococcus aureus* - ATCC 25923/ MCC 2408 and *Candida albicans* - ATCC10231 were selected for the experimental study.

Cytotoxicity studies

An *in vitro* assay was normally carried out with the monolayer cell culture was trypsinized and the cell count was adjusted to 5.0 x 10^5 cells/ ml using respective media containing 10 % FBS in half-area flat-bottomed microtiter trays. To each well of the 96 well microtiter plate, 100 µl of the diluted cell suspension (50,000 cells/ well) was added. After 24 h, when a partial monolayer was formed, the supernatant was flipped off, washed the monolayer once with medium and 100 µl of different test concentrations of test samples were added on to the partial monolayer in microtiter plates.

The plates were then incubated at 37 ºC for 24 h in 5 % CO_2 atmosphere. The reduction of

tetrazolium salts was widely accepted as a reliable way to examine cell proliferation. The yellow tetrazolium MTT (3-(4, 5-dimethylthiazolyl-2)-2, 5-diphenyltetrazolium bromide) was reduced by metabolically active cells, in part by the action of dehydrogenase enzymes, to generate reducing equivalents such as NADH and NADPH. The resulting intracellular purple formazan can be solubilized and quantified by spectrophotometric means. The assay measures the cell proliferation rate and conversely, when metabolic events lead to apoptosis or necrosis, the reduction in cell viability.

Cells cultured in T-25 flasks were trypsinized and aspirated into a 5 mL centrifuge tube. Cell pellet was obtained by centrifugation at 300 x g. The cell count was adjusted, using DMEM HG medium, such that 200 µl of suspension contained approximately 10,000 cells. To each well of the 96 well microtitre plate, 200 µl of the cell suspension was added and the plate was incubated at 37 ºC and 5 % CO_2 atmosphere for 24 h.

After 24 h, the spent medium was aspirated. 200 µl of different test concentrations of test drugs were added to the respective wells. The plate was then incubated at 37 ºC and 5 % CO_2 atmosphere for 24 h. The plate was removed from the incubator and the drug containing media was aspirated. 200 µl of medium containing 10 % MTT reagent was then added to each well to get a final concentration of 0.5 mg/mL and the plate was incubated at 37 ºC and 5 % CO_2 atmosphere for 3 h. The culture medium was removed completely without disturbing the crystals formed. Then 100 µl of solubilization solution (DMSO) was added and the plate was gently shaken in a gyratory shaker to solubilize the formed blue formazan (Mosmann, 1983).

The absorbance was measured using a microplate reader at a wavelength (optical density) of 570 nm and also at 630 nm. The percentage growth inhibition was calculated, after subtracting the background and the blank, and concentration of test drug needed to inhibit cell growth by 50 % (IC_{50}) values was generated from the dose-response curve for the cell line (Denizot and Lang, 1986; Rajashekara *et al.,* 2020). The percentage viability was calculated using following formula:

$$\%\,\text{Cell viability} = \frac{[(A_t - A_b)]}{[(A_c - A_b)]} \text{ X } 100$$

Where, A_t = absorbance value of test compound, A_b = absorbance value of blank and A_c = absorbance value of control.

RESULTS

Determination of phytochemicals profiling

Screening of the six phytochemicals (out of eight) after investigation such as alkaloids, flavonoids, phenols, saponins, steroids and tannins indicated that the clear existence of secondary metabolites in the methanolic leaf extracts of *S. zeylanica* plants (Table 1).

Table 1. Phytochemical analysis of the methanolic leaf extracts of *Sansevieria zeylanica.*

Sl. No.	Phytochemical constituents	Methanolic leaf extracts
1.	Alkaloids	+
2.	Flavonoids	+
3.	Terpenoids	-
4.	Tannins	+
5.	Glycosides	-
6.	Saponins	+
7.	Phenols	+
8.	Steroids	+

+ indicates the presence of phytochemical groups; - indicates the absence of phytochemical groups.

Anti-microbial activity

The zone of inhibition observed against the methanolic leaf extracts of *S. zeylanica* (as test compounds), ciprofloxacin (as standard for antibacterial) and clotrimazole (as standard for anti-fungal) are shown in the table 2. The zones of inhibition exhibited less than 50 % inhibitory activity against the mentioned bacterial strains such as *E. coli*, *S. aureus* and *C. albicans* by the agar well diffusion method. The methanolic leaf extractions of *S. zeylanica* have does not shown any inhibitory activity against the microorganisms (Fig. 2). Thus, the methanolic leaf extraction of *S. zeylanica* plants exhibited ordinary antibacterial activity and demonstrated without any lethal effect against these microorganisms, even at low-moderate-high concentrations.

Table 2. Minimum Inhibitory Concentration (MIC) activity of the methanolic leaf extracts of *Sansevieria zeylanica* against the microorganisms such as *Escherichia coli*, *Staphylococcus aureus* and *Candida albicans.*

Testing Microorganisms	Testing Extracts	Concentration (µg) per well			Zone of inhibition (mm)
		2.5	5.0	10.0	
Escherichia coli	Ciprofloxacin	-	-	-	-
	Methanolic leaf extract	-	-	-	45 ± 0.0
		-	-	-	47 ± 0.0
		-	-	-	47 ± 0.0
Staphylococcus aureus	Ciprofloxacin	-	-	-	-
	Methanolic leaf extract	-	-	-	51 ± 0.0
		-	-	-	52 ± 0.0
		-	-	-	54 ± 0.0
Candida albicans	Clotrimazole	-	-	-	-
	Methanolic leaf extract	-	-	-	39 ± 0.0
		-	-	-	41 ± 0.0
		-	-	-	43 ± 0.0

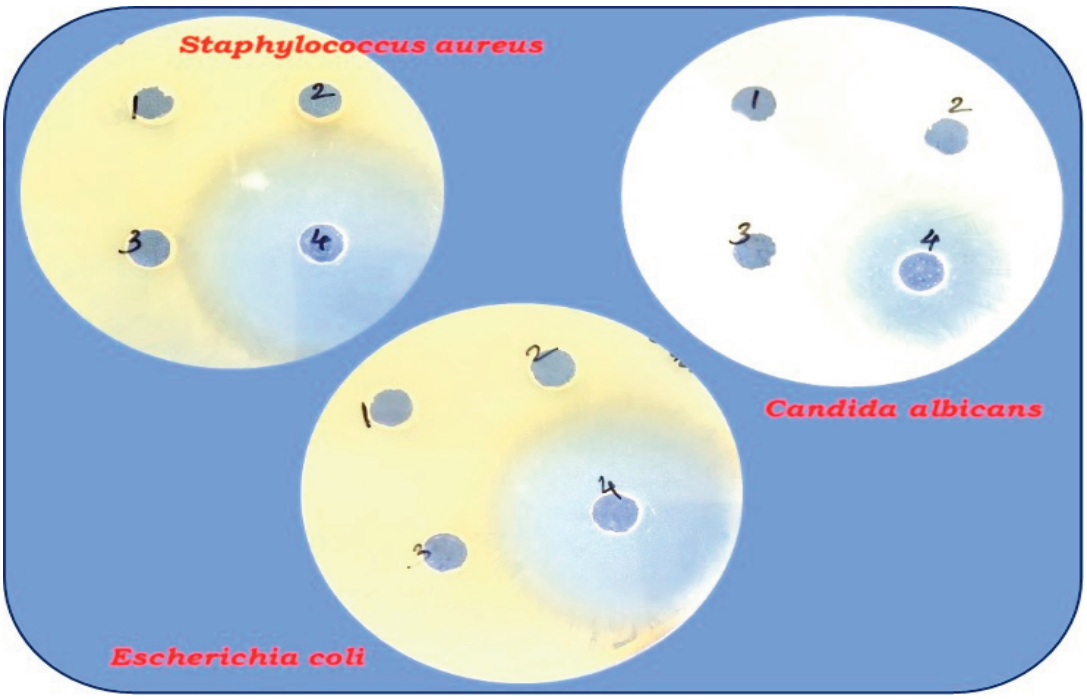

Fig. 2. Anti-microbial activity of the methanolic leaf extracts of *Sansevieria zeylanica* using a zone of inhibition assay. (1) Well 1: 2.5 mg/mL test extract (50µL); (2) Well 2: 5 mg/mL test extract (50µL); (3) Well 3: 10 mg/mL test extract (50µL); and (4) Well 4: Standard Ciprofloxacin (Antibacterial)/ Standard Clotrimazole (Antifungal) (50µL) as C – Control.

Cytotoxicity studies

In the present study, the methanolic extracts produced from leaves (aerial parts) of the *S. zeylanica* plants showed a cytotoxic effect against MDAMB-231 cell lines (Fig. 3). The test extracts showed highest inhibition of cell proliferation at 800 µg/ ml (Fig. 4 and 5). The methanolic leaf extract samples of the *S. zeylanica* for 24 h treatment showed IC_{50} value of 1167.78 µg/ ml in MDAMB-231 cells when compared to the control (Table 3).

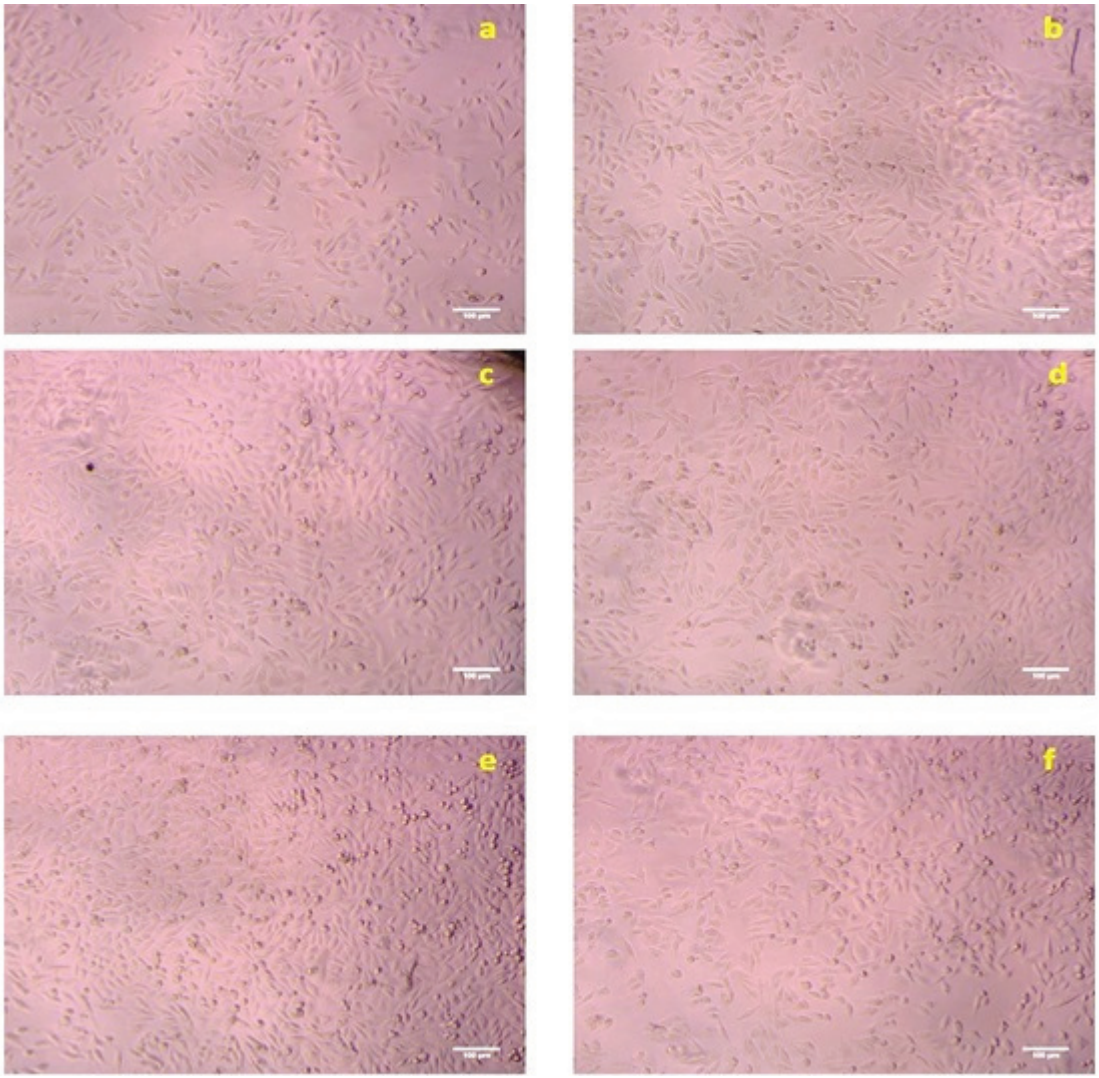

Fig. 3. Morphology of MDA-MB-231 Cell lines after the exposure to methanolic leaf extracts of the *Sansevieria zeylanica* treated with the samples of a) 50 µg/mL, b) 100 µg/mL, c) 200 µg/mL, d) 400 µg/mL, e) 800 µg/mL, and f) untreated samples.

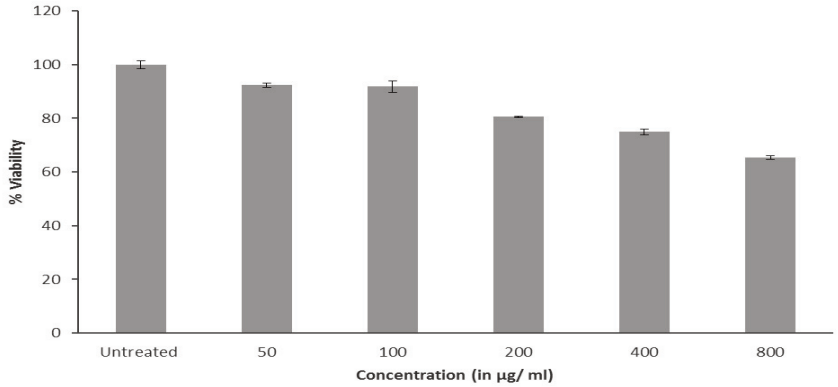

Fig. 4. Cytotoxicity studies of the methanolic leaf extracts of *Sansevieria zeylanica* in MDA-MB-231 Cell lines.

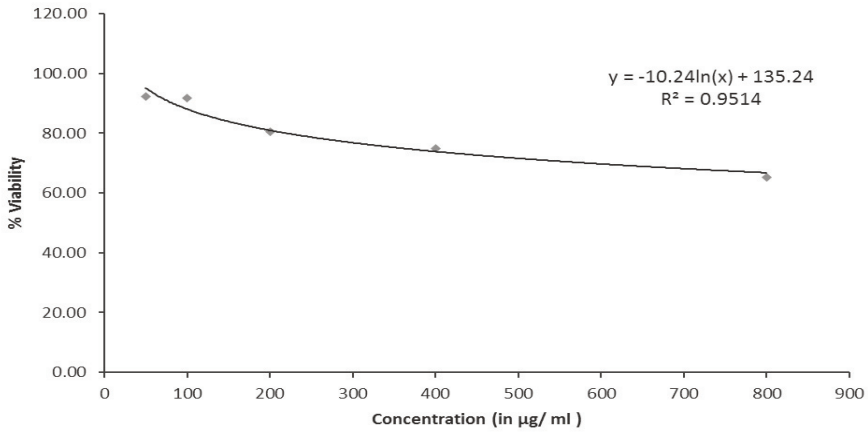

Fig. 5. Cytotoxic effect of the methanolic leaf extracts of *Sansevieria zeylanica* against the MDA-MB-231 Cells lines.

Table 3. Cytotoxicity studies of the methanolic leaf extracts of *Sansevieria zeylanica* against the MDA-MB-231 Cell lines.

Compound name	Concentration µg/ ml	OD @ 570 nm	% Inhibition	IC_{50} µg/ ml
Control	00	0.005	00.00	-
Methanolic leaf extract of *S. zeylanica*	50	0.864	92.32	1167.78
	100	0.860	91.83	
	200	0.755	80.55	
	400	0.702	74.91	
	800	0.613	65.29	

DISCUSSION

Determination of phytochemicals profiling

The phytochemicals present in the methanolic leaf extracts of the *S. zeylanica* plants showed the presence of six phytochemicals such as alkaloids, flavonoids, phenols, saponins, steroids and tannins which indicate that the clear existence of secondary metabolites. Similar kind of phyto-constituents present in the crude extracts were recorded in the leaves of various *Sansevieria* plant species such as *S. cylindrica* by Ahamad *et al.* (2017); *S. liberica* by Ikewuchi *et al.* (2010) and

Chinasa *et al.* (2011); *S. roxburghiana* by Nweze *et al.* (2004) and Philip *et al.* (2011); and *S. trifasciata* by Mimaki *et al.* (1996, 1997) and Ighodaro *et al.* (2017).

Furthermore, the phytochemical screening of isolated crystals eluted from ethyl acetate extracts of *S. zeylanica* revealed that plant leaf extracts was rich in phenols (Vysakh and Babu, 2015). It is important to characterize the different types of medicinal plants for their antioxidant potentials and anti-microbial agents, and to better understand their properties, safety and efficacy (Nascimento *et al.,* 2000). From these studies, the medicinal use of the plants supports, and divulges the opportunity of its acting as a potential source of food nutrients and nutraceuticals (Ikewuchi *et al.,* 2010).

Sansevieria sp. extracts produces the moderate to high larval mortality, and henceforth, these plant extracts could be an additional source for the control of *Aedes aegypti* as they contain a potential source of bioactive chemicals and generally free from toxicants. Applications of these natural derivatives in the control of *A. aegypti* could decrease the cost of control methods and environmental pollution (Rajashekara *et al.,* 2021). Antitumor, anti-inflammatory and anti-microbial properties of the methanolic leaf extracts of *S. zeylanica* plant are mainly due to the presence of alkaloids (Martins *et al.,* 2011). Therefore, all this *Sansevieria* spp. showed the presence of flavonoids, saponins, steroids, and tannins as a common phytochemical.

Anti-microbial activity

The methanolic leaf extraction of the *S. zeylanica* has not shown any inhibitory activity against the microorganisms such as *E. coli* (gram negative bacteria), *S. aureus* (gram positive bacteria), and *C. albicans* (fungi). The zones of inhibition were not shown any activity against the methanolic leaf extracts from the *S. zeylanica* plants exhibited less than 50 % inhibitory activity against these mentioned bacterial strains. Thus, the methanolic leaf extracts of the *S. zeylanica* exhibited ordinary antibacterial activity and demonstrated without any lethal effect against these bacterial strains, even at low-moderate-high concentrations.

While the minimum inhibitory concentrations of the different solvent and aqueous extracts of the leaves and rhizome of *S. roxburghiana* ranged from 1.0 to 8.0 mg/ ml by Agar Dilution method, and exhibited better anti-microbial activity than rhizomes (Philip *et al.,* 2011). Similarly, the ethanolic extracts of rhizome of *S. roxburghiana* plant displayed remarkable antibacterial activity against the four pathogenic bacteria such as *Salmonella typhi*, *P. fluorescens*, *P. aeruginosa*, and *E. coli* (Sethi, 2013). Anti-microbial screening revealed that there was a significant activity against *Proteus vulgaris*, *S. typhi*, *P. aeruginosa*, *Klebsiella pneumoniae*, and *E. coli* (Kumar and Kumari, 2015).

Similarly, the antibacterial test from the leaf concentrates of *S. aethiopica* shown great antibacterial action against both gram positive and gram negative microscopic organisms (David and Afolayan, 2016). Also, the methanol removes from the leaves of *S. roxburghiana* and *S. trifasciata* showed the great restraint against every one of the microorganisms. *Sansevieria roxburghiana* displayed the great hindrance impact against the *S. aureus* and *P. aeruginosa* though *S. trifasciata* showed the great enemy of microbial impact against the *E. coli, S. aureus* and *P. aeruginosa*. The consolidated impact of anti-infection agents and plant separates had upgraded the counter microbial impact of the concentrates got against pathogenic microorganisms. The methanolic separates from the leaves of *S. roxburghiana* and *S. trifasciata* was found viable against gram-positive and gram-negative pathogenic microorganisms. The 50 mg/mL of the methanolic extricates showed was discovered viable in enemy of microbial action against the microorganisms (Kingsley *et al.,* 2013).

All the extractives of *S. trifasciata* exhibited moderate anti-microbial activity, especially the methanol extracts revealed mild to moderate anti-microbial activity with zone of inhibition ranging from 10.00-14.67 mm with the highest being seen against *Vibrio mimicus* (14.67 mm). The moderate activity was found against the *Bacillus subtilis* (12.67 mm), *V. parahemolyticus* and

P. aeruginosa (12.00 mm each). The chloroform soluble fraction of this plant also revealed mild to moderate anti-microbial activity (9.00-14.00 mm), whereas the highest activity was found against the *B. cereus* (14.00 mm) (Sikder *et al.,* 2011).

The anti-microbial potential of these extracts of *S. aethiopica, S. arborescens, S. canaliculata, S. caulescens, S. cylindrica, S. francisii, S. forskaliana, S. kirkii, S. metallica, S. roxburghiana,* and *S. trifasciata* with diameters of inhibition zone from 12 to 24 mm. *Escherichia coli* isolate was resistant only to *S. hyacinthoides* extracts and the diameter of zone inhibition around the rest ranged from 8 to 10 mm. Thus, the ethanolic extracts obtained from leaves of all above mentioned plant species possess antibacterial potency against *E. coli* isolates and may be used as natural antiseptics and anti-microbial agents in medicine (Halyna *et al.,* 2017). Possibly, the efficiency of extracts is influenced by differences in the metabolism of the active compounds.

The impacts of ethanolic extricates on an in vitro against microbial movement of 17 types of *Sansevieria* Thunb. variety (*Sansevieria canaliculata* Carriere, *Sansevieria trifasciata* Prain, *Sansevieria cylindrica* Bojer ex Hook., *Sansevieria parva* N.E.Br., *Sansevieria fischeri* (Baker) Marais, *Sansevieria kirkii* Baker, *Sansevieria aethiopica* Thunb., *Sansevieria metallica* Gerome and Labroy, *Sansevieria caulescens* N.E.Br., *Sansevieria francisii* Chahin., *Sansevieria arborescens* Cornu ex Gerome and Labroy, *Sansevieria volkensii* Gurke, *Sansevieria forskaliana* (Schult. and Schult.f.) Hepper and J.R.I.Wood, *Sansevieria gracilis* N.E.Br., *Sansevieria hyacinthoides* (L.) Druce, *Sansevieria roxburghiana* Schult. and Schult. F., *Sansevieria suffruticosa* N.E.Br.) against the *E. coli*. The unrefined concentrates were evaluated for hostile to microbial action and uncovered the counter microbial probability of these concentrates. Indeed, the test organic entity was helpless to concentrates of *S. kirkii, S. arborescens, S. roxburghiana, S. francisii, S. forskaliana, S. cylindrica, S. trifasciata, S. canaliculata, S. caulescens, S. metallica* and *S. aethiopica* with measurements of restraint zone from 12 to 24 mm. *Escherichia coli* detach was safe just to *S. hyacinthoides* extricate and the distance across of zone restraint around the rest went from 8 to 10 mm. Subsequently, the ethanolic removes got from leaves of *S. kirkii, S. arborescens, S. roxburghiana, S. francisii, S. forskaliana, S. cylindrica, S. trifasciata, S. canaliculata, S. caulescens, S. metallica* and *S. aethiopica* have antibacterial intensity against *E. coli* segregates and utilized as normal sterilizers and hostile to microbial specialists in medication (Halyna *et al.,* 2017). This is a logical inconsistency to our outcomes that we have obtained in our current study.

Further investigations are required to isolate the active constituents that are responsible for the observed anti-microbial activity. However, additional investigations using the carcinoma cell line are necessary to know the effects of methanolic leaf extracts of *S. zeylanica* plants responsible for the cytotoxic activity.

Cytotoxicity studies

For screening a methanolic leaf extracts (testing compound) of pharmacological and medical importance, cytotoxicity assay has conducted for the present experimental studies. Cytotoxicity studies exhibited that the methanolic leaf extracts of the *S. zeylanica* plants which had antiproliferative properties against the MDAMB-231 breast cancer cell lines. The increase in cell death with an increase in the concentration of testing compounds signifies that the methanolic leaf extract of the *S. zeylanica* plants was found active. Further, the differences in the IC_{50}s of the methanolic leaf extracts of *S. zeylanica* in *in vitro* were reflected in the effectiveness of the extracts in the MDAMB-231 cell line model. The bioactive components of the genus *Sansevieria* predominantly belong to the six phytochemical classes that are well-known to exhibit cytotoxicity. Possibly, the effectiveness of the methanolic leaf extracts of the *S. zeylanica* plants is influenced by the differences present in the metabolism of the active compounds.

The vast majority of the cytotoxicity studies are tested at the *in vitro* level at 90 % and just

10 % of these were performed at the preclinical level, for the most part in rodents. A large portion of the mixtures were tried in mice, with just 24 % of studies being done in human cell lines. The significant human cell lines have been considered in HeLa, MCF-7, MDA-MB43, Caco-2, and Hep-G2 cell lines, which are the agent of cervical, bosom, colon, hepatic and liver carcinomas, individually (Thakur *et al.,* 2011). Raslana *et al.* (2017) achieved played out the cytotoxicity of the separates 1-6 from the methanolic concentrates of the unflowering flying pieces of S. cylindrica against the three human growth cell lines HCT116 (Colon Cancer), MCF7 (Breast Cancer) and HepG2 (Liver Cancer), utilizing doxorubicin hydrochloride as a standard medication. The IC_{50} upsides of the mixtures uncovered that compound 1 showed just a moderate cytotoxicity against MCF7. Compounds 2, 3, 6 displayed moderate cytotoxicity and compound 5 showed stamped cytotoxicity against the pre-owned cell lines.

The conclusions of the study established the therapeutic strength of *S. zeylanica* plant's roots, rhizomes and leaves can used in traditional medicine and advanced pharmacology. It provides the promising lead for the discovery of potent anti-microbial compounds in therapeutic and dietary use universally. Therefore, the finding of the present studies establishes the supportive evidence to validate folkloric use of this *Sansevieria* plant species as a remedy for various infections. Hence, the present study has been useful and helpful for the applications of pharmaceuticals, medicinal and potential applications and also, in the manufacturing of various herbicides, pesticides and agricultural fields.

CONCLUSIONS

The phytochemical analysis of methanolic leaf extracts of *S. zeylanica* plants deals with the identification of a number of secondary metabolites, in which they play prominent role as commercially important biologically active molecules having various pharmacological properties. *Sansevieria zeylanica* also exhibited ordinary anti-microbial activity and demonstrated without any lethal effect against the human pathogenic microorganisms. Furthermore, this species showed a significant cytotoxic effect of methanolic leaf extracts on the MDA MB 231 cell lines. This could be further confirmed that phytochemicals constituents found in the *S. zeylanica* plant could contribute to the present cytotoxicity. The present study provided valuable information on phytochemistry, anti-microbial activity and cytotoxicity of *S. zeylanica* and need for further study of anticancer properties, cell cycle studies, DNA fragmentation and caspase assay studies, pharmacology and toxicology, in an experimental animal model.

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AUTHOR CONTRIBUTIONS

SR: Conceptualization, Methodology, Resources, Writing - review & editing, Project administration and Supervision. NC, PR, SGH, and SS: Performed the experiments, Writing – the first draft. All authors read and provided helpful discussions for the manuscript.

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