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Efficacy of crude extracts of *Allium sativum* and *Allium cepa* against human pathogens

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ABSTRACT

Onion and garlic are best known for their pungent aromas, but these potent veggies have powerful effects on health and also there is urgent need to identify superior populations, quickly characterize and select elite candidates and breed new varieties for achieving current as well as future food and global health security needs. Hence this study is focused on the analysis of the biological activity of Allium cepa from Surandai, Alankulam and Vilathikulam and Allium sativum from Poomparai, Vadugapatti and Pannaikadu. Based on the antimicrobial activity of onion, onion from Vilathikulam was determined as the best germplasm since it showed best result towards the bacterial organisms and garlic from Pannaikadu showed best result in antimicrobial analysis revealed that this particular germplasm was best.

Keywords: Onion, garlic, human pathogens, antimicrobial activity, solvent extracts

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INTRODUCTION

Plants are a precious source of novel natural products. Among the numerous plant species around the world, only a small percentage has been experienced both phytochemically and pharmacologically. When one considers that a single plant may contain up to thousands of constituents, the possibilities of making new discoveries become evident. The crucial factor for the ultimate success of an investigation in to bioactive plant constituents is thus the selection of plant materials [1].

Allium is a monocot genus of flowering plants, informally referred to as the onion genus. The generic name *Allium* is the Latin word for garlic. The genus including the various edible onions, garlics, chives and leeks, has played a pivotal role in cooking worldwide, as the various parts of the plants, either raw or cooked in many ways, produce a large variety of flavours and textures. Various wild *Allium* species were also used intensively in folk medicine, e.g., *A.ursinum* and *A.victorialis* [2]. The regular using up of *Allium* species in food is coupled with abridged peril of neurogenerative disorders, cancer, cataract, ulcer, osteoporosis, vascular disease and heart disease [3,4].

Allium species have antimicrobial potential against bacteria, fungi, viruses, and parasites. Majority of the investigation has purposeful on the antimicrobial activity of garlic followed by onion. However, intermittent reports on other *Allium* sp. have appeared. The antibacterial efficacy of *Allium* sp. is somewhat dissimilar depending on the extraction solvents used. Water [5,6], ethyl acetate [5], and ethanol [7,8] are more frequently used compared with other solvents including acetone [5], chloroform [5,8], and butanol [5]. In our study, we determined the invitro susceptibility of human pathogens for organic extracts (petroleum ether, chloroform, methanol and water) of *Allium sativum* (garlic) and *Allium cepa* (onion) collected from three different places.

MATERIALS AND METHODS

Procurement of *Allium* species

Allium cepa was procured from three different cultivation sites, Surandai (O1), Alankulam (O2) in Tirunelveli district and Vilathikulam (O3) in Tuticorin district. *Allium sativum* was procured from Poomparai (G1) in Kodaikanal district, Vadugapatti (G2) in Theni district and Pannikadu (G3) in Kodaikanal district.

The collected *Allium* bulb from different cultivation sites were cleaned thoroughly and dried under shade. The dried bulb was blended into fine powder and stored in air tight container at room temperature for further use.

Preparation of extracts

The organic solvents such as petroleum ether, chloroform, methanol and distilled water was used for extracting the bioactive compounds from *Allium* bulb. The extraction was done using soxhlet apparatus. The extract was dried using vacuum evaporator and stored in air tight containers.

Isolation and identification of clinical pathogens

The samples such as pus, urine, sputum and throat swab were collected from Government hospital, Tirunelveli, and Sankaralingam Hospital, Nagercoil. The pathogens were isolated and identified by following the standard identification procedures.

Determination of antimicrobial activity

The Muller hinton agar (MHA) plates were swabbed with bacterial pathogens and well of 8mm diameter was punched into the MHA medium and filled with 10-50µl (100-500µg) of solvent extract. The plates were incubated at 37˚C for 24 hours. After incubation period, the diameters of zone of inhibition produced by the extract with different human bacterial pathogens in different plates were measured and recorded.

RESULTS

The clinical pathogens such as *Staphylococcus* sp., *Klebsiella* sp., *Proteus* sp., *E.coli*., and *Pseudomonas* sp. were isolated from clinical samples like pus, wound, urine and subjected for antibacterial activity by solvent extracts of garlic and onion.

Antimicrobial activity of garlic against clinical pathogens

The garlic (G1) exhibited a wide antibacterial activity against all the clinical pathogens tested was given in table 1. All the four solvent extracts such as petroleum ether, water, chloroform and methanol extract showed maximum activity against *Staphylococcus* sp. (22.3±0.58mm, 17.6±0.58mm, 14.5±0.5mm and 13.8±0.29mm respectively in highest concentration). Petroleum ether extract of G1 was active against *E.coli* and *Proteus* sp. in the range of 12.33±0.58mm to 16.5±0.5mm and 8.67±0.29mm to 13mm in 100 to 500 µg concentrations respectively.

The bioactivity of chloroform extract exhibited 10.5±0.5mm to 14.83±0.76mm against *Pseudomonas* sp. in 100 to 500 µl concentrations. Methanol extract exhibited minimum range of antibacterial spectrum range against tested human pathogens. Water extract of G1 showed antibacterial spectrum range between 9.17±0.29mm and 10.17±0.29mm zone of inhibition against *Pseudomonas* sp., 8.83±0.29mm and 10.5±0.5mm against *E.coli* in 200 and 500 µg concentrations. The activity ranges from 8.83±0.29mm to 12.83±0.29mm against *Proteus* sp., and 8.83±0.29mm and 10.33±0.58mm against *Proteus* sp., in 400 and 500 µg concentrations respectively.

Chloroform, methanol and petroleum ether extract of G2 exhibited good and notable antibacterial activity against *Staphycoccus* sp. (22.17±0.29mm, 19.5±0.5mm and 14±0.5mm) and *Proteus* sp. (14mm, 11.5±0.5mm and 11.5±0.5mm). *Klebsiella* sp. was sensitive to methanol extract in the ranges between 8.83±0.29mm and 10.83±0.29mm in 400 and 500 µg concentrations. Chloroform extract of G2 exhibited the bioactivity of 8.67±0.29mm to 9.17±0.29mm in 300 to 500 µg concentrations against *E.coli. Klebsiella* sp. and *Pseudomonas* sp. was highly resistant to chloroform extract of G2. Petroleum ether extract was found effective against *E.coli* in the range of 8.83±0.29mm to 13.5±0.5mm in 100 to 500 µg concentrations and *Pseudomonas* sp. in the range of 9.83±0.29mm to 13.33±0.58mm in 200 to 500 µg concentrations. Water extract of G2 exhibited least activity against *Klebsiella* sp. was reported in table 2.

Table 1. Antimicrobial activity of O1 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp.	12.83 ±0.29	15± 0	10.83 ±0.28	0	15 ±0.29	17 ±0	11.67 ±0.29	9.83 ±0.29	16.17 ±0.29	18.33 ±0.58	11.67 ±0.29	13 ±0	19.5 ±0.5	21.67 ±0.29	12.67 ±0.29	16 ±0	22 ±0	23.83 ±0.29	18.17 ±0.29	19 ±0
Klebsiella sp.	11.17 ±0.29	11± 0	0	0	13.17 ±0.29	11.83 ±0.29	0	0	13 ±0	11.67 ±0.29	0	9 ±0	14 ±0	13.67 ±0.29	8.83 ±0.29	9.83 ±0.29	14.67 ±0.29	14.83 ±0.29	9 ±0	10.67 ±0.29
Proteus sp.	11.83 ±0.29	9.83± 0.29	0	0	12 ±0	12.83 ±0.29	9 ±0	0	13.17 ±0.29	14.17 ±0.29	11.83 ±0.29	8.83 ±0.29	14 ±0	13.83 ±0.29	15.33 ±0.29	9 ±0	16.17 ±0.29	13.83 ±0.29	18 ±0	9± 0
E.coli	10.33 ±0.58	9± 0	8.83 ±0.29	11±0	10.67 ±0.29	8.67 ±0.29	9 ±0	12 ±0	11.33 ±0.58	9.83 ±0.29	10 ±0	11.67 ±0.58	12.17 ±0.29	11± 0	9.67 ±0.29	13.67 ±0.58	11.67 ±0.58	11.67 ±0.29	10 ±0	14.83 ±0.29
Pseudomonas sp.	0	0	0	12±0	0	0	0	12.67 ±0.29	9 ±0	8.67 ±0.29	9 ±0	13.67 ±0.29	10 ±0	9.83 ±0.29	9.17 ±0.29	17.17 ±0.29	9.83 ±0.29	11.17 ±0.29	9 ±0	17.33 ±0.29

Table 2. Antimicrobial activity of O2 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp.	14.83 ±0.29	10.83 ±0.29	10 ±0	9 ±0	15 ±0	12.83 ±0.29	13.33 ±0.58	10.17 ±0.29	16.17 ±0.29	14.17 ±0.29	15.33 ±0.58	14 ±0	18.17 ±0.29	15.33 ±0.58	16 ±0	16.33 ±0.58	20.17 ±0.29	15.83 ±0.29	18.83 ±0.29	16.33 ±0.58
Klebsiella sp.	0	0	0	0	0	0	9.17 ±0.29	0	9 ±0	10 ±0	10 ±0	10.17 ±0.29	9.17 ±0.29	12.33 ±0.58	11.17 ±0.29	11 ±0	10.17 ±0.29	12 ±0	13.83 ±0.29	11.17 ±0.29
Proteus sp.	15.17 ±0.29	0	9 ±0	0	16 ±0	9.17 ±0.29	9 ±0	0	15.83 ±0.29	8.83 ±0.29	11.33 ±0.58	9 ±0	16.83 ±0.29	11.33 ±0.58	13.17 ±0.29	10 ±0	21.67 ±0.58	12.83 ±0.29	13 ±0	10.17 ±0.29
E.coli	9 ±0	0	0	0	9 ±0	0	0	0	14.83 ±0.29	0	0	0	16.83 ±0.29	9 ±0	9.17 ±0.29	9 ±0	17 ±0	8.83 ±0.29	9.17 ±0.29	9 ±0
Pseudomonas sp.	0	0	0	18±0	18.62 ±0.29	18.62 ±0.29	0	18 ±0	18 ±0	18.62 ±0.29	0	20.62 ±0.29	19.96 ±0.29	20 ±0	18 ±0	20.62 ±0.29	20 ±0	22.62 ±0.29	21.24 ±0.58	21.5 ±0.5

Table 3. Antimicrobial activity of O3 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp	17 ±0	15.17 ±0.29	13.83 ±0.29	15.33 ±0.58	17.17 ±0.29	18 ±0	15.17 ±0.29	16.83 ±0.29	18 ±0	20.33 ±0.58	16.83 ±0.29	17 ±0	19.17 ±0.29	20.33 ±0.58	17.17 ±0.29	18 ±0	20.33 ±0.58	21.17 ±0.29	17.83 ±0.29	23.83 ±0.29
Klebsiella sp	0	19.67 ±0.29	0	19.33 ±0.58	0	22 ±0	0	19.67 ±0.29	0	23.33 ±0.29	0	22 ±0	17.67 ±0.29	23.67 ±0.29	17.67 ±0.29	22.33 ±0.58	18.33 ±0.29	24 ±0	18 ±0	23.67 ±0.29
Proteus sp	11.83 ±0.29	13±0	14.17 ±0.29	15.83 ±0.29	12 ±0	14.33 ±0.58	15.17 ±0.29	16.87 ±0.23	14.83 ±0.29	15 ±0	16.17 ±0.29	18 ±0	15.83 ±0.29	15.83 ±0.29	17.17 ±0.29	19 ±0	17 ±0	17.17 ±0.29	18 ±0	19.17 ±0.29
E.coli	0	0	0	0	8.83 ±0.29	10 ±0	8.67 ±0.29	13 ±0	9 ±0	10.67 ±0.58	8.66 ±0.29	14.66 ±0.29	10 ±0	11.17 ±0.29	8.83 ±0.29	14.66 ±0.58	11.17 ±0.29	11.83 ±0.29	10 ±0	15.83 ±0.29
Pseudomonas sp	0	0	0	9.83 ±0.29	0	0	0	10.83 ±0.29	8.83 ±0.29	9 ±0	8.83 ±0.29	12 ±0	10 ±0	9.17 ±0.29	9 ±0	14.17 ±0.29	10.33 ±0.29	10 ±0	9.17 ±0.29	15.83 ±0.29

Table 4. Antimicrobial activity of G1 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp	15.83 ±0.29	11.5 ±0.5	0	10.83 ±0.29	16.17 ±0.29	12.17 ±0.29	0	13.67 ±0.58	18.17 ±0.29	13.17 ±0.29	8.83 ±0.29	14	21.5 ±0.5	14.17 ±0.29	10.33 ±0.58	16.17 ±0.29	22.33 ±0.58	14.5 ±0.5	13.83 ±0.29	17.67 ±0.58
Klebsiella sp	0	0	0	0	0	0	0	0	0	0	0	0	9.17 ±0.29	0	8.83 ±0.29	8.83 ±0.29	9.5±0.5	8.83 ±0.29	9.83 ±0.29	10.33 ±0.58
Proteus sp	8.67 ±0.29	0	0	0	9.17 ±0.29	0	0	0	10.33 ±0.58	8.83 ±0.29	0	8.83 ±0.29	11.17 ±0.29	10.33 ±0.58	9.67 ±0.29	11 ±0.5	13	12.5 ±0.5	10.5 ±0.5	12.83 ±0.29
E.coli	12.33 ±0.58	9 ±0.5	0	0	13.83 ±0.29	9.83 ±0.29	8.67 ±0.29	8.83 ±0.29	15.67 ±0.29	10.33 ±0.29	9.17 ±0.29	9.33 ±0.58	16.17 ±0.29	11.83 ±0.29	10.17 ±0.29	9.83 ±0.29	10.5 ±0.5	13.5 ±0.5	11.83 ±0.29	10.5 ±0.5
Pseudomonas sp	0	10.5 ±0.5	0	0	0	13	0	0	0	13.17 ±0.29	0	0	8.83 ±0.29	14.17 ±0.29	8.83 ±0.29	9.17 ±0.29	10.83 ±0.29	14.83 ±0.76	9	10.17 ±0.29

Table 5. Antimicrobial activity of G2 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp	0	11.83 ±0.29	11.83 ±0.29	0	0	14.83 ±0.29	13.33 ±0.58	8.83 ±0.29	9.33 ±0.29	15.83 ±0.29	15.83 ±0.29	9.83 ±0.29	11.83 ±0.29	16.17 ±0.29	17.17 ±0.29	12.83 ±0.29	14 ±0.5	22.17 ±0.29	19.5 ±0.5	13.5 ±0.5
Klebsiella sp	0	0	0	0	0	0	0	0	9.17 ±0.29	0	0	8.83 ±0.29	9.17 ±0.29	0	8.83 ±0.29	9.17 ±0.29	9.5 ±0.5	9.17 ±0.29	10.83 ±0.29	9.83 ±0.29
Proteus sp	8.83 ±0.29	0	0	0	9.17 ±0.29	0	0	8.67 ±0.29	9.83 ±0.29	12.33 ±0.29	9.17 ±0.29	9.17 ±0.29	11.17 ±0.29	13.17 ±0.29	11	10.17 ±0.29	11.5 ±0.5	14	11.5 ±0.5	11.17 ±0.29
E.coli	8.83 ±0.29	0	0	8.83 ±0.29	10.5 ±0.5	0	0	9	11	0	8.83 ±0.29	10.17 ±0.29	12.17 ±0.29	8.67 ±0.29	12 ±0.5	10.33 ±0.58	13.5 ±0.5	9.17 ±0.29	14.83 ±0.29	11.33 ±0.58
Pseudomonas sp	0	0	0	0	9.83 ±0.29	0	9.17 ±0.29	0	12 ±0.5	0	9.17 ±0.29	8.83 ±0.29	12.83 ±0.29	0	10.17 ±0.29	10.33 ±0.58	13.33 ±0.58	8.83 ±0.29	10.5 ±0.5	10.33 ±0.58

Table 6. Antimicrobial activity of G3 against clinical pathogens

Clinical Pathogens	Zone of Inhibition (mm)/Concentration of extract (µg)																			
	100				200				300				400				500			
	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water	Petroleum ether	Chloroform	Methanol	Water
Staphylococcus sp	21.67 ±0.58	14.83 ±0.29	13.17 ±0.76	9.83 ±0.29	22.33 ±0.29	18	17.17 ±0.29	11.33 ±0.58	23	22 ±0.5	20.17 ±0.29	13	24 ±0.5	24.83 ±0.29	21.83 ±0.29	14.17 ±0.29	24.83 ±0.29	26.33 ±0.58	22.83 ±0.29	15.5 ±0.5
Klebsiella sp	0	8.67 ±0.29	8.83 ±0.29	8.67 ±0.29	0	9.17 ±0.29	9.33 ±0.29	9	9.33 ±0.29	10.33 ±0.58	10.5 ±0.5	9.5 ±0.5	10.17 ±0.29	11.17 ±0.29	12.17 ±0.29	10.17 ±0.29	10.5 ±0.5	12.17 ±0.29	14	10.17 ±0.29
Proteus sp	14.83 ±0.29	9.83 ±0.29	9 ±0.5	8.83 ±0.29	15.17 ±0.29	10.33 ±0.29	9.83 ±0.29	10	15.87 ±0.23	12.83 ±0.29	11.17 ±0.29	10.17 ±0.29	16.17 ±0.29	14.33 ±0.29	11.17 ±0.29	10.83 ±0.29	17.5 ±0.5	15.17 ±0.29	12.33 ±0.58	12.33 ±0.58
E.coli	16.83 ±0.29	0	0	8.83 ±0.29	20 ±0.5	0	9.83 ±0.29	11 ±0.5	20.83 ±0.29	8.83 ±0.29	11.17 ±0.29	11.5 ±0.5	21.5 ±0.5	11.33 ±0.29	11.33 ±0.29	12.33 ±0.29	22.83 ±0.29	12	13.17 ±0.29	12.67 ±0.58
Pseudomonas sp	9.83 ±0.29	0	8.83 ±0.29	0	10.83 ±0.29	0	10.17 ±0.29	0	11.33 ±0.29	8.83 ±0.29	11.83 ±0.29	9.83 ±0.29	14 ±0.5	9.83 ±0.29	12.33 ±0.29	10	15.17 ±0.29	11.17 ±0.29	13	10.5 ±0.5

All the four solvent extracts of G3 showed maximum antibacterial activity against *Staphylococcus* sp. Petroleum ether extract of G3 showed wider antimicrobial spectrum against *Proteus* sp. in the various concentrations tested. *Klebsiella* sp. was found sensitive to methanol and water extract. *Proteus* sp. was sensitive to chloroform extract in the range between 9.83±0.29mm and 15.17±0.29mm zone in 100 and 500 µg concentrations. Also it showed maximum of 12.33±0.58mm zone of inhibition for both methanol and water extract in 500 µg concentrations. *Pseudomonas* sp. was sensitive for petroleum ether extract in the range of 9.83±0.29mm to 15.17±0.29mm zone in 100 to 500 µg concentrations was reported in table 3.

Antimicrobial activity of onion against clinical pathogens

The onion (O1) exhibited a wide antibacterial activity against all the clinical pathogens tested. Petroleum ether and chloroform extract showed maximum activity against *Staphylococcus* sp. (22mm and 23.83±0.29mm respectively). *Proteus* sp. was sensitive to methanol extract (18mm) followed by petroleum ether extract (16.17±0.29mm). *Klebsiella* sp. was found sensitive to chloroform extract (14.83±0.29mm). Petroleum ether extract showed slightly lesser activity against *Klebsiella* sp. (14.67±0.29mm) and *E.coli* (11.67±0.58mm). *Pseudomonas* sp. was resistant to petroleum ether extract of O1. *Proteus* sp. was inhibited by chloroform extract (13.83±0.29mm) whereas methanol extract showed maximum activity against *Staphylococcus* sp. and *Proteus* sp. (18.17±0.29mm and 18mm). The remaining extracts showed less activity against other three clinical pathogens. Water extract of O1 extract exhibited wide spectrum activity against *Staphylococcus* sp. and *Pseudomonas* sp. (19mm and 17.33±0.29mm zone of inhibition). *Proteus* sp. and *Klebsiella* sp. showed resistant towards water extract (table 4).

Petroleum ether extract of O2 showed more antibacterial activity against *Proteus* sp. (21.67±0.58mm), *Staphylococcus* sp. (20.17±0.29mm) and *Pseudomonas* sp. (20mm) (table 5). It showed less activity against *Klebsiella* sp. (10.17±0.29mm). Chloroform, methanol and water extract exhibited best antibacterial activity against *Pseudomonas* sp. (22.62±0.29mm, 21.24±0.58mm and 21.5±0.5mm respectively) followed against *Staphylococcus* sp. (15.83±0.29mm, 18.83±0.29mm and 16.33±0.58mm respectively). Intermittent activity was found against *Klebsiella* sp. and *Proteus* sp. for chloroform, methanol and water extract. *E.coli* was found sensitive to petroleum ether extract whereas it exhibited resistant to other three extracts.

Petroleum ether and water extract of O3 showed maximum antibacterial activity against *Staphylococcus* sp. (20.33±0.58mm and 23.83±0.29mm) followed by activity against *Klebsiella* sp. Chloroform extract showed good activity against *Klebsiella* sp (24mm). Methanol extract showed more activity against *Klebsiella* sp. and *Proteus* sp. (18mm). *Proteus* sp. was also showed wide spectrum sensitivity pattern to water extract (19.17±0.29mm), chloroform extract (17.17±0.29mm) and petroleum ether extract (17mm). *E.coli* was intermittently sensitive to all extracts and *Pseudomonas* sp. showed more sensitivity to water extract (15.83±0.29mm) and less sensitivity to other three extracts was given in table 6.

DISCUSSION

The data obtained by Zohri *et al* [9] indicated that gram positive bacteria were more sensitive to onion oil than gram negative bacteria. Onion oil was highly active against the four gram positive bacteria tested and only one isolate of gram negative bacteria (*K.pneumoniae*, 12mm). The results by Ye *et al* [10] showed that the essential oil of onion exhibited a potent inhibitory effect against all bacteria (*E.coli, B. subtilis* and *S.aureus*) with diameter of inhibition zones ranging from 4.1mm to 19.3mm. The essential oil exerted a broad antimicrobial spectrum and showed a high antimicrobial effect on *B.subtilis*.

Adeshina *et al* [11] reported 35±0.1mm and 30±0.2mm zone of inhibition against *P.aeruginosa* by white and red onion respectively. Also they reported 19±0.5mm and 15±0.2mm zone against *E.coli*, 35±0.2mm and 28±0.1mm zone against *S.typhi* by white and red onion respectively. Among the non polar and polar subfractions of methanolic extracts of three Spanish onion varieties assayed by Santas *et al* [12], only non polar subfractions showed good antimicrobial inhibition.

All the four solvent extract of O2 was found active against *Pseudomonas* sp., and all the solvent extracts of O3 was observed active against *Klebsiella* sp. in 500 µg concentrations. Shenoy *et al* [13] reported that all these four solvent extracts showed good antimicrobial activity against *B.subtilis, S.aureus, P.aeruginosa* and *E.coli. A.cepa* extract was found ineffective against tested pathogens in Rekha and Shruti's [14] report. The maximum antibacterial effect of aqueous garlic and cinnamon extract of different temperature obtained in *Enterococcus faecalis* and *E. coli* at 60^{O}C (1.041) and in *Enterococcus faecalis* at 60^{O}C (0.87) respectively [15].

In Karuppiah and Rajaram [16] investigation, the garlic cloves extracts exhibited high degree of inhibitory activity against most of the seven tested organisms. Among the clinical pathogens, *P.aeruginosa*, *E.coli*, *Bacillus* sp.,

S.aureus and *Enterobacter* sp. were the least inhibited by garlic extracts. The diameter of zone of growth inhibition varied between 7mm and 19mm in garlic. The garlic cloves alcoholic extract showed highest diameter of zone of inhibition of 19.45mm against *P.aeruginosa* followed by *E.coli* (18.50mm) and *Bacillus* sp. (16.5mm). It showed similar zone of inhibition of 13.5mm in diameter against *Proteus* sp., *Enterobacter* sp. and *S.aureus*. Garlic (*Allium sativum*) extracts possessed antimicrobial activity against the two tested organisms at the minimum inhibitory concentrations (MICs) of 67, 134 and 201mg/ml. Results showed antibacterial activity of garlic (*Allium sativum*) against *Pseudomonas aeruginosa* and *Staphylococcus aureus* [17].

The aqueous extract of garlic showed maximum activity against *K.pneumoniae* (8mm), *Bacillus* sp. (7mm), *E.coli* (6mm) and *Streptococcus* sp. (6mm) and minimum antibacterial activity against *S.typhi* (4mm) in Saravanan *et al* [18] study. A zone of 2mm was recorded against *Bacillus* sp., *E.coli, S.typhi* by methanolic extract. The methanol extract exhibited a zone of 3mm towards *E.coli, K.pneumoniae* [18]. Onions and garlic exhibited different levels of inhibition against bacterial pathogens. In the dose response study, the inhibition zone increased with increasing concentration of extracts. Low concentration inhibited weakly on the development of bacteria. The high concentration of extracts exhibited marked inhibition activity against bacteria. Inhibition of extracts of garlic was strongest than those of extracts of onion. Benkeblia [19] was also reported the similar result.

CONCLUSION

Based on the antimicrobial activity of onion, onion from Vilathikulam was determined as the best germplasm since it showed best result towards the bacterial organisms and garlic from Pannaikadu showed best result in antimicrobial analysis revealed that this particular germplasm was best. Climatic, geographic and varietal differences might also play an important role in the composition of phytochemical components of onions and garlic. The use of *Allium* sp. will reduce the side effects and cost associated with the applications of synthetic antibiotics and will also be an eco-friendly measure.

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