INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230 – 8407

Research Article

ASSESSMENT OF BACTERIAL GROWTH INHIBITION PROPERTY AND PHYTOCHEMICAL ANALYSIS OF *OCIMUM SANCTUM* L. LEAF EXTRACT

Malay Kr Das [1], Manisha Mandal [2], Shyamapada Mandal [1]*

[1]Laboratory of Microbiology and Experimental Medicine, Department of Zoology, University of Gour Banga, Malda, India

[2]Department of Physiology, MGM Medical College and LSK Hospital, Kishanganj, Bihar, India

*Corresponding Author Email: samtropmed@gmail.com

Article Received on: 17/06/17 Approved for publication: 28/07/17

DOI: 10.7897/2230-8407.087116

ABSTRACT

Tulsi plant, *Ocimum sanctum* L., is famous for its therapeutic potentiality. The present study investigates the antibacterial activity of *O. sanctum* leaf extracts, and the bioactive components present in the extracts. The antibacterial activity of ethanolic leaf extract of *O. sanctum*: dark variety; Krishna tulsi (DOSE) and bright variety; Rama tulsi (BOSE), and aqueous leaf extract of dark variety (AqDOS) and bright variety (AqBOS) of *O. sanctum* was determined by *in vitro* methods against gram-negative and gram-positive clinical bacterial isolates. Phytochemical screening of the extracts was done qualitatively, and thin layer chromatography (TLC) was performed using n-hexane-ethyl acetate mobile phase. The ethanolic extracts showed more antibacterial activity as compared to aqueous extracts in terms of ZDI (zone diameter of inhibition); the ZDI of DOSE ranged 20 – 28 mm for gram-positive, and 14 – 23 mm for gram-negative bacteria, whereas in case of BOSE the ZDIs ranged 11 – 22 mm and 12 – 18 mm, respectively, for gram-positive and gram-negative bacteria. The R_f values of phytocomponents detected on the TLC plate, ranged 0.06 - 0.94. The *O. sanctum* leaf extracts had broad spectrum antibacterial activity and found rich source of phytochemicals, which thus, be utilized against a broad range of bacterial infection.

Keywords: *Ocimum sanctum*, antibacterial activity, zone diameter of inhibition, phytocomponents, thin layer chromatography, R_f values.

INTRODUCTION

The medicinal plants possess therapeutic potentiality because of the presence of several chemical components of varied composition that are found, as the secondary metabolites, in plant parts like leaves, fruits, stem, root, flower and seeds[1]. India is a rich source of such kind of medicinal plants. A majority of the world's population, especially in the developing countries, depends on herbal medicines to meet the primary health needs[2].

Tulsi, which is called the holy basil, and scientifically known as *Ocimum sanctum* L. (=*Ocimum tenuiflorum*), belongs to the family Lamiaceae[3], and is popular one for its therapeutic potentiality to treat many diseases[4]. The plant is native to the Indian Subcontinent and widespread as a cultivated plant throughout the Southeast Asian tropics[5]. Two varieties of *O. Sanctum*, commonly found in the Indian include dark variety or the Krishna tulsi and bright variety or the Rama tulsi[2,6,7].

In the traditional system of medicine, different parts (leaves, stem, flower, root, seeds and even whole plant) of *O. sanctum* have been recommended for the treatment of several health disorders including diarrhoea and dysentery[8]. It has been demonstrated that the stem and leaves of *O. sanctum* possess several bioactive compounds such as saponins, flavonoids, triterpenoids, tannins[9] as well as phenolic compounds[10], which have great therapeutic importance in curing many diseases, and are also responsible for antimicrobial activity [11,12]. Possessing enormous number of bioactive components[6,13], *O. sanctum* potentiality inhibit the growth of several bacterial pathogens including *Escherichia coli* (*E. coli*), *Pseudomonas aeruginosa* (*P. aeruginosa*), *Salmonella enterica* serovar Typhi (*S. typhi*), *Staphylococcus aureus* (*Staph. aureus*) and *Bacillus subtilis*[4,14-16].

In our region, there is abundance of both the varieties of *O. sanctum* (dark and bright), but no scientific report has been documented on the antibacterial activity of this plant available in the local niches. Therefore, the present study was designed to explore the antibacterial potentiality of *O. sanctum* leaf extracts and to screen the bioactive constituents contained in them.

MATERIAL AND METHODS

Bacterial strains

The randomly selected bacteria, for the current study, included gram-negative (*E. coli*, *Klebsiella pneumonia*, *Proteus vulgaris*, *P. aeruginosa*, *S. typhi*, *Acinetobacter baumannii*) and gram-positive (*Staph. aureus* and *Bacillus cereus*) clinical isolates. The control strains used were *E. coli* MTCC 443 and *Listeria monocytogenes* MTCC 657.

Collection of plant materials

The leaves from two indigenous variety of *O. sanctum*: Krishna tulsi (dark variety) and Rama tulsi (bright variety) were collected from Khanta village of Uttar Dinajpur district, West Bengal state (India). The leaves were washed properly with distilled water, shed dried and grinded using an electronic grinding machine, and stored in airtight containers at room temperature for extract preparation as per the requirement.

Preparation of extract

For the preparation of *O. sanctum* leaf extracts, ethanol and water were used as the solvents. The ethanolic extracts were prepared following the protocol described earlier[17]. Twenty five gram of powdered leaves was dissolved in 200 ml of ethanol for 48 h with shaking at regular intervals. The liquid phase of the extract was filtered with Whatman No.1 filter paper, following filtration through a sterile cheese cloth, and stored in refrigerator at 4°C for further use. The aqueous extracts were prepared by dissolving the 25 g of the powder, of each variety, in 200 ml distilled water, and boiled for 30 min, in water bath, filtered as mentioned above after cooling. The concentration of all the extracts prepared: ethanolic leaf extract of *O. sanctum* dark variety (DOSE) and bright variety (BOSE), and aqueous leaf extract of *O. sanctum* dark variety (AqDOS) and bright variety (AqBOS), in the stock solution, was 0.125 mg/µL.

Antibacterial activity of plant extract

The antibacterial activity of the plant extracts was performed by disk diffusion method[18], using nutrient agar medium; the detail of the method has been described elsewhere[17]. The extract concentrations used were 3.75 and 6.25 mg/disc. The zone diameter of inhibition (ZDI) values were recorded and interpreted according to Mandal *et al*.[19]: the ZDIs ≥ 7 mm were indicative of sensitivity of the test bacterial isolates to the *O. sanctum* leaf extracts.

Phytochemical screening

To ascertain the presence of specific bioactive compounds in *O. sanctum* ethanolic and aqueous leaf extracts, different methods were followed, as described by Radhakrishnan *et al*.,[20], for quinones, phenols, steroids, terpenoids and flavonoids, by Ayoola *et al*.[21], for cardiac glycosides, and by Joshi *et al*.[22] and Devi *et al*.[4] for anthraquinone glycosides and saponins, respectively.

Thin layer chromatography

The *O. sanctum* leaf extracts (DOSE, BOSE, AqDOS and AqBOS) were applied in spot forms, using glass capillaries, on a precoated silica gel $60F_{254}$ TLC plates (Merck, India), with a developing distance of 1.5 cm, among four tracks. The plate was developed inn-hexane–ethyl acetate (8:2 v/v) solvent system in a developing chamber. The TLC plate was air dried, after removing it from the developing chamber, when the solvent moved a predetermined distance of 15 cm from the origin. The colour components detected on the TLC plate were photographed in visible light. The TLC plate was then placed in an iodine chamber and examined under visible as well as UV light (365 nm). The TLC fingerprints of *O. sanctum* leaf extracts were recorded by photography. The movement of the compounds was expressed with their retention factor (R_f) values, calculated according to Gujjeti and Mamidala[23]:

$$R_f = \frac{Distance\ travelled\ by\ the\ solute}{Distance\ travelled\ by\ the\ solvent}.$$

RESULTS AND DISCUSSION

The *O. sanctum*, in India, remains a famous and the most sacred plant that played an important role in ancient medicine to modern research due to its remedial properties against the wide array of illnesses[8,24]. In the current study, following disc diffusion technique, the antibacterial activity of all the test extracts has been determined (Figure 1). The ethanolic *O. sanctum* leaf extracts (DOSE and BOSE) had superior growth inhibition activity compared to the aqueous extracts, AqDOS and AqBOS (Figure 2); the ZDIs of DOSE ranged 20 – 28 mm for gram-positive and 14 – 23 mm for gram-negative bacteria, while the ZDIs of BOSE ranged 11 – 22 mm and 12 – 18 mm, respectively, for gram-positive and gram-negative bacteria. The research on different parts of various plants has been increased, in recent times, all over the world, as the consequence of emerging multidrug resistance among bacterial pathogens[19]. The *O. sanctum* leaves have displayed equal efficacy against the gram-negative as well as gram-positive bacteria[14]. The methanolic extract of *O. sanctum* showed strong antibacterial activity against *Staph. aureus* and *Staph. saprophyticus* (ZDI: 20 mm) as compared to other test bacterial isolates[25]. Krishnan and Nair[26] reported that the ethanolic leaf extract of *O. sanctum* had highest ZDI (19 mm) at 0.05 g concentration against *P. aeruginosa*. Worth mentioning, the *O. sanctum* leaf extracts displayed concentration dependent antibacterial activity against both gram-positive and gram-negative test bacteria. The antimicrobial activity of ethanolic *O. sanctum* leaf extract has been reported to be augmented with increased concentration of the extracts as well as the time of exposure, and found more efficacious than the aqueous *O. sanctum* leaf extracts[27]. The variation in antimicrobial activity of a plant was due to the presence of varied quantity and number of secondary metabolites in different solvent extracts [28,29].

The medicinal plants are rich in secondary metabolites of therapeutic importance[30]. Herein, the ethanolic (DOSE and BOSE) and aqueous (AqDOS and AqBOS) extracts of *O. sanctum* were screened for the presence of bioactive phytochemicals. All the *O. sanctum* extracts were tested positive for cardiac glycosides, anthraquinone glycosides, steroids and quinones, terpenoids were not found in BOSE, while saponins and phenols were detected, respectively in the ethanolic (DOSE and BOSE) and aqueous (AqDOS and AqBOS) extracts (Table 1). Prasad *et al*.[31] reported the presence of cardiac glycosides, anthraquinones, terpenoids, flavonoids, tannins, saponins and lignins in *O. sanctum*. Various extracts of *O. sanctum* leaves showed the presence of alkaloids, glycosides, volatile oils, flavanoids, terpenoids and tannins[32]. Reddy *et al*.[33] demonstrated the presence of saponins, alkaloids, flavonoids, cardiac glycosides, carbohydrates, terpenoids and tannins in ethanolic extract of *O. sanctum* leaves. The *O. sanctum* aqueous and methanolic leaf extracts, which were screened to contain steroids, alkaloids, tannins and reducing sugars, had growth inhibitory activity against *Staph. aureus*, *E. coli* and *Pr. mirabilis*[34]. Haniffa and Shanthi[35] documented the presence of tannins and flavonoids in the *O. sanctum* methanolic leaf extract showing growth inhibitory activity against *Aeromonas hydrophila* (ZDI: 15 mm). In the current study the presence of various bioactive compounds in *O. sanctum* leaf extracts might be responsible in displaying broad spectrum antibacterial activity (against both gram-negative and gram-positive pathogenic bacteria).

Table 1: Phytoconstituents present in the test plant extracts

Phytoconstituents	Plant extracts			
	DOSE	BOSE	AqDOS	AqBOS
Flavonoids	-	-	-	-
Cardiac Glycosides	+	+	+	+
Anthraquinone Glycosides	+	+	+	+
Steroids	+	+	+	+
Terpenoids	+	-	+	+
Quinones	+	+	+	+
Phenols	+	+	+	+
Sapponins	+	+	-	-

DOSE: ethanolic leaf extract of *O. sanctum*: dark variety; BOSE: ethanolic leaf extract of *O. sanctum*: bright variety; AqDOS: aqueous leaf extract of *O. sanctum*: dark variety; AqBOS: aqueous leaf extract of *O. sanctum*: bright variety; +: presence of the compound; –: absence of the compound.

Table2: R_f values of various phytocomponents in *O. sanctum* leaf extracts detected on TLC plate

Plant Extract	Fraction Number	Visibility of spot		R_f value
		UV Light	Visible Light	
DOSE	1	Visible	Visible	0.12
	2	Visible	Visible	0.22
	3	Visible	Visible	0.30
	4	Visible	Visible	0.43
	5	Visible	Visible	0.52
	6	Visible	Not Visible	0.58
	7	Visible	Visible	0.69
	8	Visible	Visible	0.80
	9	Visible	Not Visible	0.86
	10	Visible	Visible	0.94
AqDOS	1	Visible	Not Visible	0.29
	2	Visible	Not Visible	0.39
	3	Visible	Not Visible	0.84
BOSE	1	Visible	Not Visible	0.06
	2	Visible	Visible	0.12
	3	Visible	Visible	0.24
	4	Visible	Visible	0.30
	5	Visible	Visible	0.38
	6	Visible	Visible	0.41
	7	Visible	Visible	0.49
	8	Visible	Not Visible	0.56
	9	Visible	Visible	0.64
	10	Visible	Visible	0.76
	11	Visible	Not Visible	0.86
	12	Visible	Visible	0.93
AqBOS	1	Visible	Not Visible	0.29
	2	Visible	Not Visible	0.39
	3	Visible	Not Visible	0.84

DOSE: ethanolic leaf extract of *O. sanctum*: dark variety; AqDOS: aqueous leaf extract of *O. sanctum*: dark variety; BOSE: ethanolic leaf extract of *O. sanctum*: bright variety; AqBOS: aqueous leaf extract of *O. sanctum*: bright variety; R_f: retention factor

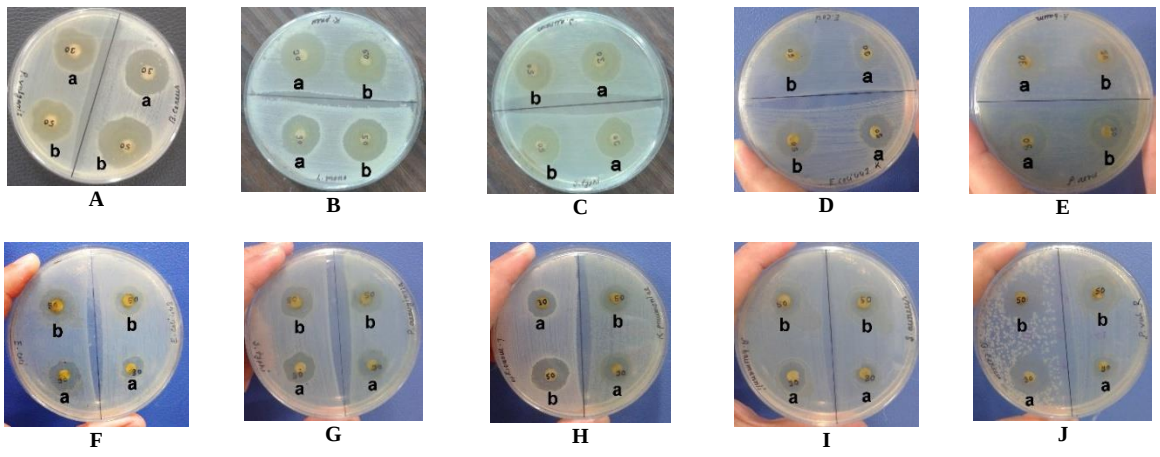

Figure 1: Antibacterial activity of *O. sanctum* leaf extracts; A-E; dark variety ethanolic extract; F-J; bright variety ethanolic extract. a= 3.75 mg; b= 6.25 mg. The clear halos around each disc on the plates are indicative of growth inhibitory action of the extracts.

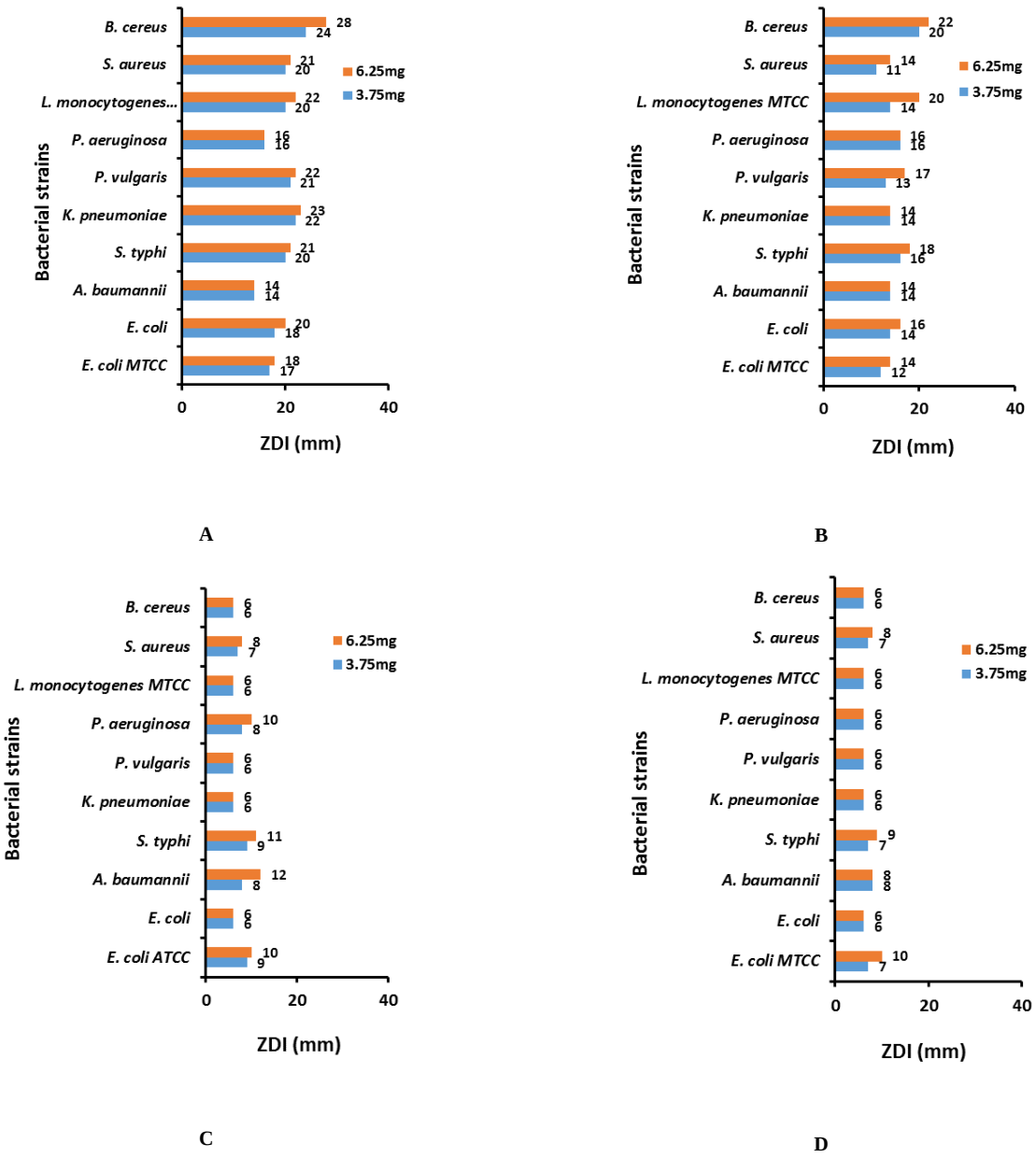

Figure 2: The ZDI (Zone diameter of inhibition) values due to the action of *O. sanctum* leaf extracts by disc diffusion method; A= ethanolic extract of dark variety; B= ethanolic extract of bright variety; C= aqueous extract of dark variety; D= aqueous extract of bright variety.

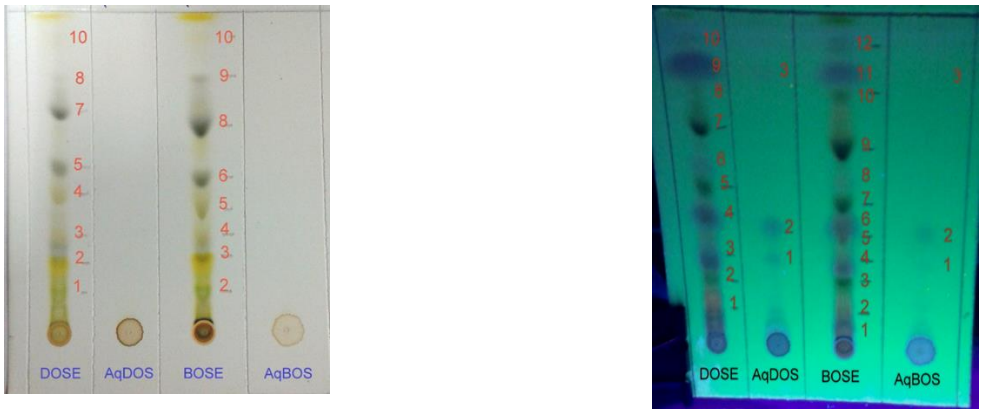

Figure 3: TLC chromatogram of *Ocimum sanctum* leaf extracts in n-hexane–ethyl acetate solvent system. A: spots detected in visible light; B: spots detected in UV light; DOSE: ethanolic leaf extract of *O. sanctum*: dark variety; AqDOS: aqueous leaf extract of *O. sanctum*: dark variety; BOSE: ethanolic leaf extract of *O. sanctum*: bright variety; AqBOS: aqueous leaf extract of *O. sanctum*: bright variety.

Thin layer chromatography (TLC) is important for the separation and detection of phytocomponents present in plant extracts. The most of the spots, on the TLC plate, from DOSE and BOSE, in the current study, were detected in visible as well as UV light, while the spots from AqDOS and AqBOS were seen in UV light only (Figure 3). The *O. sanctum* ethanolic extracts showed more number of spots, with R_f values 0.06-0.94, than the *O. sanctum* aqueous extracts, conferring R_f values 0.29 - 0.84 (Table 2). The TLC chromatogram revealed the presence of two components (R_f values: 0.13 and 0.63) in *O. sanctum* leaf ethanolic extract, and such components were found active against bacterial pathogens[36]. Reddy *et al*. [33], following TLC analysis in 'chloroform-methanol-water' (10:10:3) solvent system, demonstrated flavonoids content (R_f value: 0.82) in *O. sanctum* leaf ethanolic extract. The chromatographic variation, in TLC study, might be due to the difference in polarity of solvent system[37, 38], variation in the methods of extraction and the solvents used in the extraction process, stage of maturity of the leaves, seasonality as well as the geographical variation.

CONCLUSION

The *O. sanctum* (black and bright variety) contained several bioactive phytoconstituents: phenolics, tannins, terpenoids, saponins, quinones and glycosides, in the leaf ethanolic as well as aqueous extracts, of which the former had excellent antibacterial activity against both gram-negative and gram-positive human pathogenic bacteria. The presence of such bioactive compounds in the leaf extracts of the test plant were validated by TLC chromatogram, and thus, the capacity of antibacterial activity of the plant might be attributed to such active compounds, alone or in combination. Therefore, the *O. sanctum* leaves, which are enormously available in the local niches from this part of the globe, might be utilized as the source of alternative and non-antibiotic agents in order to combat bacterial infection.

REFERENCES

1. Tharun, Rao KN, Padhy SK, Dinakaran SK, Banji D, Avasarala H, *et al*. .Pharmacognostic, phytochemical, antimicrobial and antioxidant activity evaluation of *Amaranthus tricolor* Linn. Leaf. Asian Journal of Chemistry 2012; 24:455-460.
2. Rahman S, Islam R, Kamruzzaman M, Khasrul A, Abu HMJ. *Ocimum sanctum* L.: A review of phytochemical and pharmacological profile. American Journal of Drug Discovery and Development 2011; DOI: 10.3923/ajdd.2011.
3. Nahak G, Mishra RC, SahuRK.Taxonomic distribution, medicinal properties and drug development potentiality of *Ocimum* (Tulsi). Drug Invention Today 2011; 3: 95-113.
4. Naik LS, Shyam P, Marx KP, Baskari S, Devi VR. Antimicrobial activity and phytochemical analysis of *Ocimum tenuiflorum* leaf extract. International Journal of PharmTech Research 2015; 8:88-95.
5. Warrier PK. In: Longman O editor. Indian medicinal plants. 1st ed. New Delhi: CBS publication; 1995. p. 168.
6. Kumar PK, Kumar MR, Kavitha K, Singh J, Khan R. Pharmacological actions of *Ocimumsacntum*– review article. International Journal of Advances in Pharmacy, Biology and Chemistry 2012; 1:406-414.
7. Bhatt MK, Shankar MB, Saluja AK, Dholwani KK, Captain AD. Evaluation of anti-microbial activity of *Ocimum sanctum* methanolic extract. Journal of Pharmaceutical and Scientific Inovation 2012; 4:39-41.
8. Luthra D. *Ocimum sanctum* (Tulsi): A potent medicinal herb. Webmed Central 2010; 1:1-12.
9. Jaggi RK, Madaan R, Singh B. Anticonvulsant potential of holy basil, *Ocimum sanctum* Linn. and its cultures. Indian Journal of Experimental Biology 2003; 41: 1329-1333.
10. Pattanayak P, Behera P, Das D, Panda SK.*Ocimum sanctum* Linn. A reservoir plant of therapeutic applications: an overview. Pharmacognosy Reviews 2010; 4:95-105.
11. Lobo V, Patil A, Phatak A, Chandra N. Free radicals, antioxidants and functional foods: impact on human health. Pharmacognosy Reviews 2010; 4:118-126.
12. Ahmad I, Beg AZ. Antimicrobial and phytochemical studies on 45 Indian medicinal plants against multi-drug resistant human pathogens. Journal of Ethnopharmacology 2001; 74:113-123.
13. Tewari D, Sah AN, Pandey HK, Meena HS.A review on phytoconstituents of *Ocimum* (Tulsi). International Journal of Ayurvedic Medicine 2012; 3:1-9.
14. Mishra P, Mishra S. Study of antibacterial activity of *Ocimum sanctum* extract against gram positive and gram negative bacteria. American Journal of Food Technology 2011; 6:336-34.
15. Mandal S, Mandal MD, Pal NK. Enhancing chloramphenicol and trimethoprim in vitro activity by *Ocimum sanctum* Linn. (Lamiaceae) leaf extract against *Salmonella enterica* serovar Typhi. Asian Pacific Journal of Tropical Medicine 2012; 5:220-224.
16. Rahman MS, Khan MMH, Jamal MAHM. Anti-bacterial evaluation and minimum inhibitory concentration analysis of *Oxalis corniculata* and *Ocimum sanctum* against bacterial pathogens. Biotechnology 2010; 9:533-536.
17. Das MK, MandalS. *Syzygium cumini* and *Mangifera indica* seed extracts: *In vitro* assessment for antibacterial activity alone and in combination with antibiotics against clinical bacteria. Journal of Infectious Diseases and Preventive Medicine 2016; 4:1-6.
18. Bauer AW, Kirby WM, Sherris JC, Turk M. Antibiotic susceptibility testing by a standardized single disc method. American Journal of Clinical Pathalogy 1996; 45: 493.
19. Mandal S, Pal NK, Mandal MD. Synergistic anti-*Staphylococcus aureus* activity of amoxicillin in combination with *Emblica officinalis* and *Nymphae odorata* extracts. Asian Pacific Journal of Tropical Medicine 2010; 3:711-714.
20. Radhakrishnan K, Thangamani P, Balakrishnan V. Antibacterial and phytochemical analysis of stem and root extracts of *Calotropis gigantea* against selected pathogens. Malaya Journal of Biosciences 2014; 1:49-55.
21. Ayoola GA, Coker HB, Adesegun SA, Adepoju-Bello AA, Obaweya K, Ezennia EC, *et al*. . Phytochemical screening and antioxidant activities of some selected medicinal plants used for malaria therapy in southwestern Nigeria. Tropical Journal of Pharmaceutical Research 2008; 7:1019–1024.
22. Joshi A, Bhobe M, Saatarkar A. Phytochemical investigation of the roots of *Grewia microcos* Linn. Journal of Chemical and Pharmaceutical Research 2013; 5: 80–87.
23. Gujjeti RP, Mamidala E. Phytochemical screening and thin layer chromatographic studies of *Aervalanata* root extract. International Journal of Innovative Research in Science, Engineering and Technology 2013; 2:5725-5730.
24. Bansod S, Rai M. Antifungal activity of essential oils from Indian medicinal plants against human pathogenic *Aspergillus fumigates* and *A. niger*. World Journal of Medical Sciences 2008; 3:81-88.
25. Tantry BA, Kumar A, Rahiman S, Tantry MN. Antibacterial evaluation and phytochemical screening of methanolic extract of *Ocimum sanctum* against some common microbial pathogens. Global Advanced Research Journal of Microbiology; 5:10-15.

26. Krishnan RJ, Nair SR. Preliminary study on the antibacterial activity of six medicinal plants against two naso-pharyngeal pathogens—*Streptococccus pyogenes* and *Pseudomonas aeruginosa*. American Journal of Plant Sciences 2016; 7:907-915.
27. Sadul RR, Gidde MR, Bipinraj NK. Comparative study of antimicrobial activity and phytochemical screening of aqueous and alcoholic leaf extract of *Ocimum sanctum* on *E. coli* (faecal indicator of water pollution). Journal of Environmental Research and Development 2012; 7:312-320.
28. Sen A, BatraA. Evaluation of antimicrobial activity of different solvent extracts of medicinal plant: *Melia azedarach* L. International Journal of Current Pharmaceutical Research 2012; 4:67-73.
29. Sarah SMA, Lamia AMA. Estimation of the phytochemical constituents and biological activity of Iraqi *Ocimum sanctum* L. extracts. International Journal of Pharma and Bio Sciences 2015; 6: 999-1007.
30. Bhateja S, Arora G. Therapeutic benefits of holy basil (tulsi) in general and oral medicine: a review. International Journal of Research 2012; 3:761-764.
31. Prasad MP, Jayalakshmi K, Rindhe GG. Antibacterial activity of *Ocimum* species and their phytochemical and antioxidant potential. International Journal of Microbiology Research 2012; 4:302-307.
32. Jain S, ArgalA. Preliminary phytochemical screening and micromeretic parameters of *Ocimum sanctum* L. Asian Journal of Plant Science and Research 2013; 3:126-130.
33. Reddy RR, Venkateshwarlu G, Laxmi P, Ramana H, Vasanthi R. Phytochemical analysis and antimicrobial activity of *Ocimum sanctum*. World Journal of Pharmacy and Pharmaceutical Sciences 2015; 4:823-829.
34. Singh AR, Bajaj VK, Sekhawat PS, Singh K. Phytochemical estimation and antimicrobial activity of aqueous and methanolic extract of *Ocimum sanctum* L. Journal of Natural Product and Plant Resources 2013; 3:51-58.
35. Haniffa MA, ShanthiP.Phytochemical analysis and antibacterial screening of medicinal plants against *Aeromonas hydrophila*. Asian Journal of Pharmaceutical and Clinical Research 2012; 5:101-103.
36. Dahiya P, Purkayastha S.Phytochemical screening and antimicrobial activity of some medicinal plants against multidrug resistant bacteria from clinical isolates. Indian Journal of Pharmaceutical Sciences 2012; 74:443-450.
37. Raha A, Erlina A, Parveen J, Dzun NJ. Purification of antibacterial compounds from *Spathiphyllum cannifolium* leaf. Der Pharma Chemica 2013; 5:350-357.
38. Ganatra SH, Durge SP, Patil SU. Preliminary phytochemicals investigation and TLC analysis of *Ficus racemosa* leaves. Journal of Chemical and Pharmaceutical Research 2012; 4:2380-2384.

Cite this article as:

Malay Kr Das *et al*. Assessment of bacterial growth inhibition property and phytochemical analysis of *Ocimum sanctum* L. leaf extract. Int. Res. J. Pharm. 2017;8(7):46-51 http://dx.doi.org/10.7897/2230-8407.087116

Source of support: Nil, Conflict of interest: None Declared