**INTRODUCTION**

*Solanum tuberosum* (L.) Millsp. is an annual shrub belonging to the family Solanaceae and is grown in many countries for its nutritional value. The seeds serve as vegetables and are very nutritious. The leaves are used for the treatment of scurvy, as a food source, and as a source of raw materials for industrial purposes. The seeds, leaves, and flowers are used for medicinal purposes, and the roots are used for food and industrial purposes.

The search for the plants with antibacterial activity has gained importance in recent years due to the development of multidrug resistance by microbes and the occurrence of undesirable side effects of some antibiotics [7]. The possible mechanisms of resistance by microbes and the importance of traditional medicine which has compounds derived from various plant extracts against different bacterial species have been studied.

**MATERIALS AND METHODS**

**Collection and processing of plant materials**

The plant parts of *C. cajan* were collected from the research field, Department of Biotechnology, Kakatiya University, Warangal, Telangana. The plant parts were washed and then stored at room temperature. The concentrated extracts were stored in air tight containers.

**Preparation of plant extracts**

Powdered each plant material (15g/100 mL) was extracted separately by successive soaking for 2-3 days with aqueous and organic solvents viz., acetone, chloroform, ethanol and methanol for each sample in separate containers. The extracts were then filtered using water, evaporated to dryness at room temperature. The concentrated extracts were stored in air tight containers until use.

**Chemicals**

All the chemicals and antibiotics used were of analytical grade and were purchased from Himedia (Mumbai, India).

**Test organisms**

Gram negative bacterial strain *Escherichia coli* and gram positive strain *Staphylococcus aureus* were obtained from Department of Microbiology, Kakatiya University, Warangal. They were maintained at 4°C on the slants of nutrient agar medium for further use.

**Antibacterial activity**

*In vitro* antibacterial activity was analysed for crude extracts of root, seed, and whole plant parts of *C. cajan* against pathogenic bacteria species *S. aureus* and *E. coli* using agar well diffusion method as described by Opera and Anasa [13]. 0.2 mL of 24h broth...
culture of the test microorganisms was introduced aseptically and spread evenly on the surface of gelled sterile Muller-Hinton agar plates using bent sterile glass rod. 5 wells of 6.0 mm diameter were punched using a sterile cork borer for various solvent extracts in each petri plate containing overnight lawn culture of E. Coli and S. aureus respectively. The various plant extracts and standard streptomycin of fixed volumes (0.1 ml) were added into wells and then incubated at 37°C for 24h. Antimicrobial activity was evaluated by measuring the diameter of the zone of inhibition (ZI in mm).

**Minimum Inhibitory Concentration (MIC)**

The MIC was determined for methanolic extract against S. aureus and ethanolic extract against E. coli of leaf, seed, root, pod and flower parts of C. cajan. MIC was found out through the broth dilution method [14]. 200 µl of overnight grown bacterial cultures (10⁸ cells/ml) were incubated for 24 hrs at 37°C. Streptomycin (0.100 mg/ml) was used as positive control and solvent methanol (100 µl) was used as negative control. The test tubes were transferred into test tubes containing different concentrations (0.050-0.500 mg/ml) of leaf, seed, root, pod and flower extracts separately, prepared by dissolving in 1 ml nutrient broth.

Streptomycin (0.100 mg/ml) was used as positive control and solvent methanol (100 µl) was used as negative control. The test tubes were incubated for 24 hrs at 37°C and were analysed for visible turbidity. The MIC values can be determined as the lowest possible concentration that inhibits the growth of microorganism [15, 16].

**Statistical analysis**

The antibacterial activity of leaf, seed, root, pod and flower extracts of C. cajan was indicated by clear zones of growth inhibition. All the experiments were performed in triplicate and the data were statistically analysed as Mean ± SE (standard error) by following the method of Pillai and Sinha [17].

**RESULTS**

**Antibacterial activity**

*In vitro* antibacterial activity of different plant parts of C. cajan was performed using agar well diffusion method. The results of the study showed that the aqueous and organic solvent extracts viz. acetone, chloroform, ethanol, and methanol) of leaf, seed, root, pod and flower parts of C. cajan had shown prominent antibacterial activity against the pathogenic bacteria studied (tables 1-3, fig. 1). Highest activity of methanolic extracts against S. aureus and ethanolic extracts against E. coli was observed in all the plant parts of C. cajan tested. On the other hand, chloroform extract showed least activity in leaf, seed, root, pod and flower extracts against bacteria studied. Among the five plant parts tested pod extracts showed the least activity against both the pathogenic bacteria. Highest ZI was exhibited by methanol leaf extract (25.5±0.08) against the gram +ve bacteria S. aureus, followed by seed (22.1±0.09), root (22.1±0.09), flower (21.9±0.05) and pod extracts (20.8±0.14) respectively (table 1).

**Minimum Inhibitory Concentration (MIC)**

The results showed that the MIC value of leaf, seed, root, and flower was ranging between 0.38 and 0.512 mg/ml for both the pathogenic bacteria. It has been identified that an MIC of 0.38 mg/ml was recorded for methanolic leaf extracts and 0.385 mg/ml for ethanol leaf extracts against S. aureus and E. coli respectively (table 3).
and also with studies of Ezeifeka et al. [19] have reported that S. aureus was found to be sensitive for aqueous and ethanolic extracts of leaf, seed extracts while E. coli was found to be resistant to aqueous, seed extracts of C. cajan as we found in the present investigations. The results of the study showed that the organic solvent extracts were more effective than the aqueous extracts. The difference in the observed activities of various extracts is due to varying degrees of solubility of the bioactive constituents in the solvents used. It has been described that the various solvents have diverse solubility capacities for different phytoconstituents [20]. The effect of aqueous and various organic solvent extracts of different plant parts of C. cajan for antibacterial activity was determined to be varied among the organisms tested. The activity showed by all the extracts was almost similar or somewhat greater than the standard (streptomycin) which consistently displayed much activity when compared with the extracts on S. aureus and E. coli. This may be attributed to the fact that streptomycin is a pure compound compared with the doses of leaf extracts of C. cajan used.

CONCLUSION
The antibacterial activity of C. cajan against both the gram positive and gram negative bacteria is an indication that the plant is a potential source for production of drugs with a broad spectrum of antibacterial activity. Methanolic extracts of all the plant parts showed better antibacterial activity against S. aureus, while ethanolic extracts were found to be better on E. coli. From the results of our study it is concluded that antibacterial extracts of C. cajan may be helpful in treatment of many infectious enteric diseases, as the extracts of all the major parts of C. cajan were effective in controlling the growth of enteropathogenic bacteria.

ACKNOWLEDGEMENT
Ms. Mahitha Banala is greatly thankful to University Grants Commission, New Delhi for financial assistance as UGC-BSR Research Fellow (UGC Sanction Ltr. No. F.4-1/2006(BSR) /7-211/2009(BSR); dt. 26-02-2013) and to the Department of Microbiology, Kakatiya University for supplying the pathogenic bacteria.

CONFLICT OF INTERESTS
Declared None.

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