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Original Research Article

Phytochemical Screening, Antioxidant and Antibacterial properties of *Taxillus cuneatus* (Roth.) Danser- A Hemi-parasitic Angiosperm

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A B S T R A C T

Taxillus cuneatus (Roth.) Danser, an evergreen hemi-parasitic flowering plant belongs to the family Loranthaceae growing on *Spondias pinnata* (L.f.) Kurz was collected from Western Ghats of Karnataka and subjected for qualitative phytochemical analysis, antibacterial and antioxidant activity. In the present study, *T. cuneatus* was subjected for phytochemical analysis in different solvent extracts which revealed the presence of reducing compounds, alkaloids, flavonoids, saponins, tannins, sterols, terpenoids, cardiac glycosides, glycosides, carbohydrates and absence of anthraquinones, proteins and amino acids. The methanolic extract of the plant showed total phenolic content of about 33 µg of GAE in 100 µg of plant extract. Antioxidant and reducing power activities of methanol extract revealed dose dependent activity, which increased with increase in the concentration of the extract. Ethyl acetate and methanolic extracts exhibited moderate antibacterial activity against the tested bacterial pathogens. The present investigation has thrown a light on the effect of parasitic plant *T. cuneatus* on antioxidant and antibacterial activities, so it can be further subjected for purification of compounds which may act as an alternative for the present synthetic compounds which are used as pharmaceuticals.

Keywords

Taxillus cuneatus, Secondary metabolites, Total phenols, DPPH, Antibacterial

Introduction

Nature has been a source of medicinal agents for thousands of year because of their traditional medicinal practice (Mithraja et al., 2012). A remarkable number of modern drugs have been isolated from medicinal plants which have led to sudden increase in the number of herbal drug (Boopathi and Sivakumar, 2011). Medicinal plants with therapeutic properties are used for the treatment of many infectious diseases of humans as they contain many bioactive phytochemical constituents which are of curative effects (Sanaa et al., 2012). The medicinal properties of the plants are mainly due to the presence of secondary metabolites like alkaloids, cardiac glycosides, tannins, flavonoids, saponins, reducing compounds, minerals and vitamins (Vinoth et al., 2011). However,

the secondary metabolites are of great medicinal interest as they have significant biological activities and the actual active constituents of many crude drugs are still unknown.

Reactive oxygen species which create oxidative stress cause human diseases and disorders such as heart disease, inflammation, atherosclerosis, stroke, cancer, diabetes mellitus, malaria, HIV/ AIDS, etc., (Rackova et al., 2007). Antioxidants derived from plants contain generally, the phenolics which have many biological activities such as anti-inflammatory, anti-cancer and anti-microbial (Gambhire et al., 2009; Mirzaei et al., 2013). Plants also have the capability to safeguard the body from oxidative damage by scavenging the free radicals and inhibiting peroxidation and other radical mediated processes (Gyekyel et al., 2012). Due to the profitable efficiency of medicinal plants on biological activities, there is a need for isolation of newer biological compounds from plants which can serve as novel drugs.

Taxillus belonging to the family Loranthaceae has many medicinal values. Many species of *Taxillus* have medicinal values and are used in traditional medicine such as *T. theifer* (anti-hypertensive), *T. liquidambaricola* (antioxidant, analgesic and anti-inflammatory), *T. chinensis* (anti-obesity, anti-inflammation, antioxidant, immunomodulatory effects and anti-cancer), *T. sutchuenensis* (antioxidant, anti-imflammatory and antiproliferative) and *T. ramulus* (antioxidant, anti-imflammatory activity, neuroprotective, hypolipidemic effects, treatment of atherosclerosis and it prevent the renal toxic effects) (Chiu, 1996; Huang et al., 2008; Wang et al., 2008; Zhang et al., 2011; Deng et al., 2011; Lee et al., 2012; Liu et al., 2012; Zhang et al., 2013). In the present investigation, *Taxillus cuneatus* (Roth.) Danser an parasitic angiosperm was subjected for its preliminary phytochemical analysis and other biological activities for the first time.

Materials and Methods

Collection of plant material

The fresh plant material (leaves) of *Taxillus cuneatus* growing on *Spondias pinnata* (Anacardiaceae) was collected from Western Ghats of Karnataka, India. The plant was identified with the help of Flora of Presidency of Madras (Gamble, 1935) and a voucher specimen is deposited in the Herbarium, Department of Studies in Botany, University of Mysore, Manasagangotri, Mysore, Karnataka, India.

Preparation of the extracts

The fresh leaves of *T. cuneatus* was washed under running tap water, shade dried and powdered using wearing blender. 50 gm of dried leaf powder was filled in the thimble and successfully extracted with petroleum ether; chloroform; ethyl acetate and methanol using Soxhlet extractor. All the extracts collected were concentrated using rotary flash evaporator and stored at 4° C in air tight vials and used for further studies (Harborne, 1973).

Phytochemical Screening

The collected plant extracts were subjected to qualitative phytochemical screening for identification of various classes of active chemical constituents like reducing compounds, anthraquinones, alkaloids, flavonoids, saponins, tannins, cardiac glycosides, glycosides, sterols, terpenoids, carbohydrates, proteins and amino acids

using the method described by Harborne (1973) and Trease and Evans (1987).

Determination of Total Phenolics

Total phenolic in methanol extracts was determined by the method of Singleton et al (1999). 20 µl of extract (5 mg/ ml) was mixed with 0.75 ml of 20% sodium carbonate solution and 0.25 ml of Folin-Ciocalteau reagent. The reaction mixture was allowed to stand in light for 3 min and incubated for 2 h in dark. The absorbance was measured at 765 nm using UV-Visible Spectrophotometer. Total phenolics were quantified by calibration curve obtained from measuring the absorbance of known concentrations of Gallic acid standard (0-100 µg/ ml). The concentrations were expressed as µg of Gallic acid equivalents per ml.

Antioxidant activity by DPPH method

The free radical scavenging capacity of the methanolic extract of the plant was determined by DPPH (2,2-diphenyl-1-picrylhydrazyl) method (Sultanova et al., 2001). The reaction mixture contained 5 µl of plant extract and 95 µl of DPPH (300 µM) in methanol. Different concentrations (100-1000 µg/ ml) of test sample were prepared, while the concentration of DPPH remained same. These reaction mixtures were incubated at 37º C for 30 min and the absorbance was measured at 517 nm. Per cent Radical Scavenging Activity (RSA) upon sample treatment was determined by comparison with a methanol treated control. All the determinations were performed in triplicates. Ascorbic acid was used as positive control. The per cent RSA was calculated using the formula:

$$\text{RSA \%} = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Reducing Power Assay

Reducing power estimation was carried out as described previously by Nagulendran et al (2007) with slight modifications. 0.75 ml of methanolic plant extract solution (1 mg/ ml) was mixed with 0.75 ml of 0.2 M phosphate buffer (pH 6.6) and 0.75 ml of 1% potassium ferricyanide and incubated at 50º C for 20 min. Then, 0.75 ml of 10% trichloroacetic acid was added to the mixture, which was then centrifuged at 3000 rpm for 10 min. Finally, 1.5 ml of the supernatant solution was mixed with 1.5 ml of distilled water and 0.5 ml of 0.1% $FeCl_3$. Absorbance was measured at 700 nm in UV-Visible Spectrophotometer using phosphate buffer as blank and butylated hydroxyl toluene (BHT) as standard. The experiments were performed in triplicates.

Antibacterial activity

The ethyl acetate and methanol extracts of plant were dissolved to prepare a stock solution of 50 mg/ ml. The extracts were tested for antibacterial activity with slight modifications (Singh et al., 2009) against pathogenic Gram-positive (*Staphylococcus aureus* MTCC 7443, *Bacillus subtilis* MTCC 121) and Gram-negative (*Escherichia coli* MTCC 7410, *Salmonella typhi* MTCC 733) bacteria. Streptomycin (1 mg/ ml) was used as standard antibacterial agent. All the microbial cultures were adjusted to 0.5 McFarland standards, which is visually comparable to a microbial suspension of approximately $1.5x10^8$ cfu/ mL. 20 ml of nutrient agar media was poured into each Petri plate, allowed to solidify under aseptic condition and plates were swabbed with 50 µl inocula of the test bacteria and kept for 15 min for adsorption. Sterile discs of 6 mm diameter were loaded with a 10, 20, 30 and 40 µl volume of ethyl acetate and

methanol extracts (50 mg/ ml) were seeded on agar plates. All the plates were incubated at 37º C for 24 h. Antibacterial activity of ethyl acetate and methanol extracts was evaluated by measuring the zone of growth inhibition against the test organisms. The medium with appropriate solvent was used as a negative control whereas streptomycin 10 µg/ disc used as positive control. The experiments were performed in triplicates.

Statistics

The values are mean ± SD of triplicate determinations. The data were analysed by ANOVA followed by Tukey's HSD test for significant differences using SPSS 11.0 computer software. IC_{50} values were calculated by Boltzmann's dose response analysis using Origin 6.1 computer software.

Results and Discussion

Phytochemical Screening

The solvent extracts of *T. cuneatus* revealed the presence of secondary metabolites such as reducing compounds, alkaloids, flavonoids, saponins, tannins, cardiac glycosides, glycosides, sterols, terpenoids and carbohydrates (Table 1). The results also revealed that, anthraquinones, proteins and amino acids were absent in all the solvent extracts of the plant.

Determination of Total Phenolics

The total phenolic content in the methanol extract of *T. cuneatus* was determined as Gallic Acid Equivalent (GAE). The extract showed concentration dependent increase in phenolic content. Tested methanol extract had good phenolic content of 33 µg of GAE in 100 µg of plant extract.

Antioxidant activity by DPPH assay

The antioxidant activity of the methanol extract measured as free radical scavenging activity is presented in Fig. 1. The leaf extract of *T. cuneatus* revealed a considerable antioxidant activity (IC_{50} = 102 µg/ ml) in DPPH method. The results also showed that the activity was dose dependent which increased with increase in the concentration of the extract (Fig. 1) which was similar to that of standard. Ascorbic acid showed 50% inhibition at 40 µg/ ml.

Reducing Power Assay

The reducing power ability of *T. cuneatus* extract was compared with standard BHT. An increase in absorbance at 700 nm indicated the reducing power of the extract. The methanolic extract of the plant showed promising amount of reducing power ability which reflected its antioxidant potential. Reducing ability of the methanolic extract of the tested plant increased with respect to increase in the concentration (Fig. 2).

Antibacterial activity

The antibacterial activity of ethyl acetate and methanol leaf extracts at different concentrations of *T. cuneatus* against some of the tested Gram positive and Gram negative pathogenic bacteria are presented in Table. 2. Among the different concentrations tested, extracts treated at 2 mg/ disc showed broad spectrum activity against different test pathogens, but no activity was observed at other concentrations. *B. subtilis* was highly susceptible showing 12.53 mm and 15.13 mm activity to ethyl acetate and methanol extracts, respectively followed by *S. typhi*, *S. aureus* and *E. coli*. The positive control streptomycin offered a maximum of 29.66 mm activity against *B. subtilis* and a minimum of 24.93 mm activity against *E. coli*.

Table.1 Qualitative Phytochemical Analysis of *T. cuneatus* leaf extracts

Secondary Metabolites	Petroleum ether	Chloroform	Ethyl acetate	Methanol
Reducing Compounds	--	++	--	++
Saponins				
a. Foam Test	--	--	++	++
Alkaloids				
a. Wagner's Test	++	++	++	++
b. Dragendorff's Test	--	--	++	++
c. Mayer's Test	--	--	--	++
d. Hager's Test	++	--	--	++
Tannins				
a. Ferric chloride test	--	--	--	++
b. Gelatin Test	--	--	--	--
Sterols				
a. Libermann-Burchard's Test	++	--	--	++
Terpenoids				
a. Libermann-Burchard's Test	--	++	++	--
Anthraquinones	--	--	--	--
Flavonoids				
a. Ferric Chloride Test	--	--	--	++
b. Alkaline reagent Test	--	--	--	++
Cardiac glycosides				
a. Keller-Kilani Test	++	++	++	++
Glycosides				
a. Borntrager's Test	--	--	--	--
b. Baljet Test	++	++	++	++
Proteins and Amino acids				
a. Ninhydrin Test	--	--	--	--
b. Biuret Test	--	--	--	--
Carbohydrates				
a. Benedict's Test	--	--	--	--
b. Fehling's Test	--	++	++	++

++ : Present; -- : Absent

Table.2 Antibacterial activity of *T. cuneatus* leaf extracts against test bacterial species

Extract	Concentration	Zone of inhibition (mm)			
		S. aureus	***B. subtilis***	***E. coli***	***S. typhi***
Ethyl acetate	0.5 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	1 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	1.5 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	2 mg/ disc	10.80±0.80	12.53±0.50	10.43±0.58	11.60±0.52
Methanol	0.5 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	1 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	1.5 mg/ disc	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
	2 mg/ disc	13.46±0.50	15.13±0.41	12.2±0.72	12.43±0.40
Solvent Control		0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Streptomycin		27.50±0.50	29.66±0.61	24.93±0.90	26.50±0.50

Values are mean inhibition zone (mm) ± S.D of three replicates

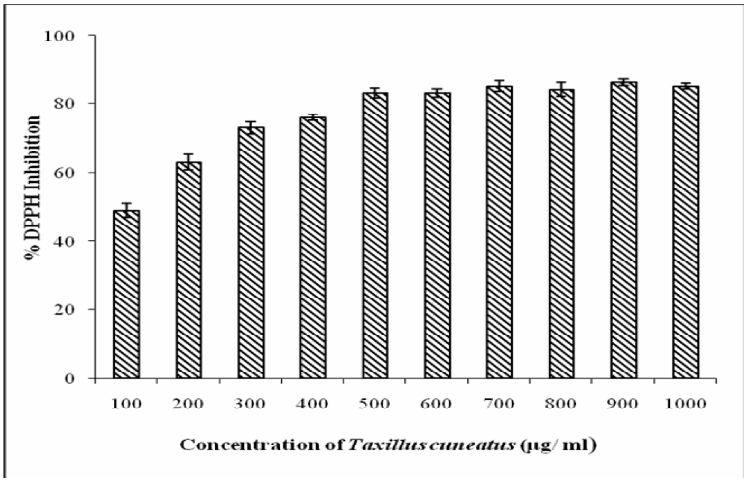

Fig.1 Antioxidant activity by DPPH method of methanolic extract of *T. cuneatus* at different concentrations. Values are mean ± S.D. of three replicates

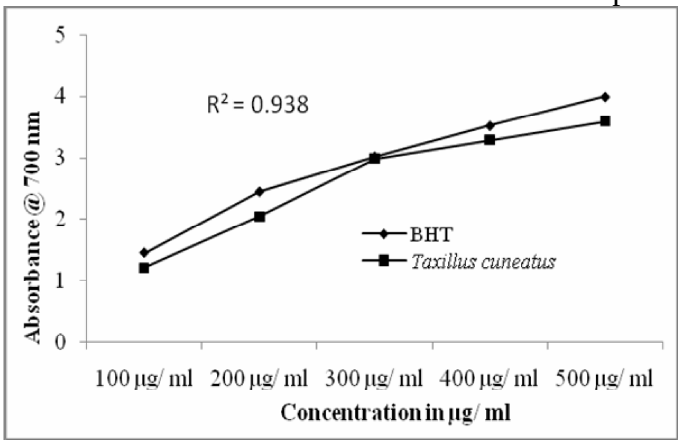

Fig.2 Reducing power of *T. cuneatus* methanolic extract at different concentrations compared with BHT

About 70-80% of the world population is dependent on herbal medicine especially in the developing countries as they have good affinity towards human body without any harmful effects and nearly 21,000 plants are used for this purpose as reported by World Health Organization (WHO). The medicinal value in plants is due to some chemical elements which are responsible for physiological functions in the human body (Liu, 2003). These chemical elements are called phytochemicals (alkaloids, tannins, flavonoids, saponins, sterols, triterpenes and many other compounds) which are found in the plants as product of plant metabolism or synthesized for defence purposes and they are either toxic or useful to human body (Usman and Osuji, 2007). Species of Loranthaceae consists of rich source of phytochemical constituents and are said to have potential medicinal properties including anti-hypertensive, anti-obesity, anti-inflammation, antioxidant, immunomodulatory effects, antiproliferative, anti-cancer, neuroprotective, hypolipidemic effects, treatment of atherosclerosis and also prevent the renal toxic effects (Alleykutty et al., 1993; Osadebe et al., 2004; Pattanayak and Sunita, 2008; Chiu, 1996; Huang et al., 2008; Wang et al., 2008; Zhang et al., 2011; Deng et al., 2011; Lee et al., 2012; Liu et al., 2012; Zhang et al., 2013).

Taxillus spp. are known to posses many medicinal properties and used in traditional medicines. In the present investigation *Taxillus cuneatus* was subjected for determination of phytochemical constituents using different types of solvents. The extracts revealed the presence of secondary metabolites such as flavonoids, saponins, alkaloids, tannins, reducing compounds, sterols, tri-terpenes and absence of anthraquinones. The presence of these secondary metabolites are known to have therapeutic activity against several diseases and therefore could suggest its traditional use for the treatment of various illness (Yousuf et al., 2012). Earlier studies have reported that flavonoids have antibacterial property as they have the capability to associate with soluble proteins and bacterial cell walls (Doss et al., 2011). These flavonoids also have antioxidant property as they inhibit oxidative and hydrolytic enzymes, have impact on radical scavenging, anti-inflammatory and anti-cancerous activity (Liu et al., 2008; Alsabri et al., 2013). Similarly saponins are reported to act adversely on bacteria and fungi so they are reported to have antimicrobial (Rohit et al., 2012), anticancerous and many health benefits (Shi et al., 2004), while alkaloids are used for their antiparasitic, antioxidant, anticancerous and antimicrobial activity (Alsabri et al., 2013) and tannins are reported to have antimicrobial, antidiarrhhoel, anti-inflammatory, antioxidant activities and have astringent property (Killedar and More, 2010).

Plant phenolic compounds are main contributors of antioxidant activity and are also responsible for anti inflammatory, antiviral and anticancerous and antimicrobial activities (Yang et al., 2013). The present investigation revealed that the extract of *T. cuneatus* has good phenolic content. Similar results are obtained by Murali et al (2011) and Puneetha et al (2013) wherein the extracts of mistletoes showed total phenol content. Free radicals could play an important role in the degenerative or pathological processes of a range of serious diseases (Chin-Yuan et al., 2007). Many plants are exploited for their antioxidant activity to replace the synthetic one as they have no side effects

and used for the treatment of many dangerous diseases such as cancer, diabetes, stroke, atherosclerosis and Alzheimer's disease (Mosquera et al., 2007). The DPPH radical scavenging activity is an extensively used method to estimate the antioxidant activity and the present study on methanolic extract of *T. cuneatus* showed an enhanced antioxidant activity with increase in the concentration of the extract. The higher radical scavenging activity of *T. cuneatus* seems to be directly correlated with its total phenolic content as it may play an important role in its antioxidative effect. The results were in line with Deng et al (2011), where the ethanolic extracts of *T. liquidambaricola* showed Antioxidant, analgesic, and anti-inflammatory activities. Another important indicator of antioxidant activity is reducing power of compounds which are electron donors and have reductones and perform as primary and secondary antioxidants (Li and Lin, 2010). Reducing power of phytochemical compounds is actively dependent to the antioxidant activity (Yildirim et al., 2001). Similarly, the methanolic extract of *T. cuneatus* showed both antioxidant as well as reducing power ability.

Now-a-days many microbes causing various diseases have become resistance to several old and new pharmaceutics and researchers are exploring traditional plants for their medicinal properties. There are number of reports on antibacterial activities from plant source (Abdel-Hameed et al., 2012; Yang et al., 2013). Similarly in the current investigation, the crude extracts of the *T. cuneatus* were tested to check its potency against pathogenic bacteria. The results showed varied degree of antibacterial activity with respect to the pathogen tested, solvent extract and its concentration. Likewise, there are reports on extracts of mistletoes used in antimicrobial activity (Osadebe and Ukwueze, 2004; Pattanayaka and Sunita, 2008; Efuntoye et al., 2010).

The present investigation has thrown a light on the availability of various sources of secondary metabolites present in *T. cuneatus* and its effect on antioxidant and antibacterial activities. Further, the extracts of *T. cuneatus* are subjected for purification of compounds which may act as an alternative for the present synthetic compounds used as pharmaceuticals.

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References

Abdel-Hameed ES, Bazaid SA, Shohaye MM, El-Sayed MM, El-Waki EA. 2012. Phytochemical studies and evaluation of antioxidant, anticancer and antimicrobial properties of *Conocarpus erectus* L. growing in Taif, Saudi Arabia. Eur. J. Med. Pl. 2(2):93-112.

Alleykutty NA, Srinivasan KK, Gundu RP, Udupa AC, Keshavamurthy KR. 1993. Diuretic and antilithiatic activity of *Dendrophthoe falcata*. Fitoterapia 64:325-331.

Alsabri SG, El-Basir HM, Rmeli NB, Mohamed SB, Allafi AA, Zetrini AA, Salem AA, Mohamed SS, Gbaj A, El-Baseir. 2013. Phytochemical screening, antioxidant, antimicrobial and anti-proliferative activities study of *Arbutus pavarii* plant. J. Chem. Pharm. Res. 5(1):32-36.

Boopathi AC, Sivakumar R. 2011. Phytochemical screening studies on the leaves and stem of *Andrographis neesiana* wight - An endemic medicinal plant from

India. World App. Sci. J. 12(3):307-311.

Chin-Yuan H, Chan Yu-Pei C, Chang J. 2007. Antioxidant activity of extract from *Polygonum cuspidatum*. Biol. Res. 40:12-21.

Chiu ST. 1996. Loranthaceae. In "Flora of Taiwan". 2nd edn Vol. II, Editorial Committee of the Flora of Taiwan. Taipei, Taiwan, R.O.C. pp. 269-285.

Deng J, Chi C, Huang S, Shie P, Lind T, Huang G. 2011. Antioxidant, analgesic and anti-inflammatory activities of the ethanolic extracts of *Taxillus liquidambaricola*. J. Ethnopharmacol. 137:1161-1171.

Doss A, Parivuguna V, VijayaSanthi M, Sruthi S. 2011. Antibacterial and preliminary phytochemical analysis of *Medicago sativa* L. against some microbial pathogens. Indian J. Sci. Tech. 4(5):550-552.

Efuntoye MO, Ayodele AE, Thomas BT, Ajayi TO. 2010. Does host plant affect the antibacterial activity of *Tapinanthus bangwensis* (Engl. and K. Krause) Danser (Loranthaceae)? J. of Med. Pl. Res. 4(13):1281-1284.

Gambhire MN, Wankhede SS, Juvekar AR. 2009. Antiinflammatory activity of aqueous extract of *Barleria cristata* leaves. Pharmacogn. 1:222-224.

Gamble JS. 1916-1935. The flora of the Presidency of Madras, 3rd Vol., BSI, Calcutta.

Gyekyel IJ, Antwi DA, Bugyei KA, Awortwe C. 2012. Comparative study of two *Kalanchoe* species: total flavonoid, phenolic contents and antioxidant properties. Afr. J. App. pure Chem. 6(5):65-73.

Harborne JB. 1973. Phytochemical Methods. Chapman and Hall. Ltd., London pp. 49-188.

Huang HB, Li KX, Liu T, Zeng, CQ, Lin J, Qiu, M. 2008. Kang Zhong Liu ZhongYao Lin Chuang Ying Yong Yu Tu Pu. (Clinical application of anti-tumor Chinese medicine) (1st edn). Guang Zhou: Guangdong Science and Technology Press.

Killedar SG, More HN. 2010. Estimation of tannins in different parts of *Memecylon umbellatum* Burm. J. Pharm. Res. 3(3):554-556.

Lee G, Lee J, Ham KK, Lee H, Kim H, Lee H, Kim H, Lee H, Hong M, Shin M, Bae H. 2012. Cisplatin induced nephrotoxicity is inhibited by *Taxilli Ramulus*. Mol. Cell Toxicol. 8:311-315.

Li C, Lin E. 2010. Antiradical capacity and reducing power of different extraction method of *Areca catechu* seed. Afr. J. Biotechnol. 9:7831-7836.

Liu RH. 2003. Health benefit of fruits and vegetable are from additive and cynergic combinations of phytochemicals. Am. J. Clin. Nutr. 517S-520S.

Liu X, Zhao M, Wang J, Yang B, Jiang Y. 2008. Antioxidant activity of methanolic extract of emblica fruit (*Phyllanthus emblica* L.) from six regions in China. J. Food Compos. Anal. 21(3):219-228.

Liu C, Lin Y, Deng J, Liao J, Peng W, Huang G. 2012. Antioxidant, anti-inflammatory and antiproliferative activities of *Taxillus sutchuenensis*. The Am. J. of Chin. Med. 40(2): 335-348.

Mirzaei A, Toori MA, Mirzaei N, Shirazi R. 2013. Antioxidant, antimicrobial and antimutogenic potential of 4 Iranian medicinal plants. Life Sci. J. 10(7):1085-1091.

Mithraja MJ, Irudayaraj D, Kiruba S, Jeeva S. 2012. Antibacterial efficacy of *Drynaria quercifolia* (L.) J. Smith (Polypodiaceae) against clinically isolated urinary tract pathogens. Asian Pac. J. Trop. Biomed. S131-S135.

Mosquera OM, Correa YM, Buitrago DC, Nio J. 2007. Antioxidant activity of twenty five plants from Colombian biodiversity. Mem. Inst. Oswaldo Cruz. 102:631-634.

Murali M, Puneetha GK, Thriveni MC, Niranjan MH, Shivamurthy GR, Niranjana SR, Prakash HS, Amruthesh KN. 2011. Phytochemical screening and antioxidant activity of hemi-parasitic Indian mistletoe *Viscum nepalense* Sprengel. J. of Pharm. Res. 4(10):3348-3350.

Nagulendran KR, Velavan S, Mahesh R, Hazeena Begum V. 2007. *In vitro* antioxidant activity and total polyphenolic content of *Cyperus rotundus* rhizomes. Eur. J. Chem. 4:440-449.

Osadebe PO, Ukwueze SE. 2004. Comparative study of the antimicrobial and

phytochemical properties of mistletoe leaves sourced from six host trees. J. Biol. Res. and Biotech. 2(1):18-23.

Osadebe PO, Okide GB, Akabogu IC. 2004. Study on the anti-diabetic activity of crude methanolic extracts of *Loranthus micranthus* (Linn.) sourced from five different host trees. J. Ethnopharmacol. 95:133-138.

Pattanayak SP, Sunita P. 2008. Wound healing, anti-microbial and antioxidant potential of *Dendrophthoe falcata* (L.f.) Etting. J. Ethnopharmacol. 120:241-247.

Puneetha GK, Thriveni MC, Murali M, Shivamurthy GR, Niranjana SR, Prakash HS, Sadashiva MP, Amruthesh KN. 2013. Evaluation of a parasitic flowering plant *Dendrophthoe trigona* (Wt. & Arn.) Danser for its phytochemical and antioxidant activities. J. of Pharm. Res. 7:20-23.

Rackova L, Oblozinsky D, Kostalova V, Kettmann V, Bezakova L. 2007. Free radical scavenging activity and lipoxygenase inhibition of *Mahonia aquifolium* extract and isoquinoline alkaloids. J. Inflamm. 4:15-22.

Rohit S, Thakur GS, Sanodiya BS, Mukeshwar P, Prakash B. 2012. Saponin: a wonder drug from *Chlorophytum* species. Global J. Res. Med. Plants Indigen. Med. 1(10):503-515.

Usman H, Osuji JC. 2007. Phytochemical and *in vitro* antimicrobial assay of the leaf extract of *Newbouldia leavis*. Afr. J. Tradit. Complement Altern. Med. 4(4):476-480.

Sanaa M, Shananab M, Emad AS. 2012. Biological activates and anticorrosion efficiency of water hyacinth (*Eichhornia crassipes*). J. of Med. Pl. Res. 6(23):3950-3462.

Singh DP, Kumar K, Sharma C. 2009. Antimicrobial active macrocyclic complexes of Cr(III), Mn(III) and Fe(III) with their spectroscopic approach. Eur. J. Med. Chem. 44:3299-3304.

Singleton VL, Orthofer R, Lamuela-Raventos RM. 1999. Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin Ciocalteu reagent. Methods Enzymol. 299:152-177.

Sultanova N, Makhmoor T, Abilov ZA, Parween, Z, Omurkamzinova, VB, Rahman A, Iqbal CM. 2001. Antioxidant and antimicrobial activities of *Tamarix ramosissima*. J. Ethnopharmacol. 78:201-205.

Trease GE, Evans WC. 1987. Pharmacognosy. Bailliare Tindall, London.

Vinoth S, Rajesh KP, Gurusaravanan P, Jayabalan N. 2011. Evaluation of phytochemical, antimicrobial and GC-MS analysis of extracts of *Indigofera trita* L.F. spp. Subulata (Vahl ex poir). Int. J. Agric. Res. 6(4):358-367.

Wang Y, Deng M, Zhang SY, Zhou ZK, Tian WX. 2008. Parasitic loranthus from Loranthaceae rather than Viscaceae potently inhibits fatty acid synthase and reduces body weight in mice. J. Ethnopharmacol. 118:473-478.

Yang C, Chang H, Lin H, Chuang L. 2013. Evaluation of antioxidant and antimicrobial activities from 28 Chinese herbal medicines. J. Pharmacogn. Phytochem. 2(1):294-305.

Yildirim A, Oktay M, Bilaloglu V. 2001. The antioxidant activity of the leaves of *Cydonia vulgaris.* Turk. J. Med. Sci. 31:23-27.

Yousuf M, Aslam K, Wani BA, Aslam N, Dar NA, Nawchoo IA. 2012. *In vitro* antibacterial activity and phytochemical studies of methanolic extract of leaves of *Hypericum perforatum* L. growing wild in Kashmir Himalaya. Asian J. Pl. Sci. and Res. 2(4):414-420.

Zhang L, Koyyalamudi SR, Jeong SC, Reddy N, Bailey T, Longvah T. 2013. Immunomodulatory activities of polysaccharides isolated from *Taxillus chinensis* and *Uncaria rhyncophylla*. Carbohydr. Polymers 98:1458-1465.

Zhang L, Ravipati AS, Koyyalamudi SR, Jeong SC, Reddy N, Smith PT, Bartlett J, Shanmugam K, Munch DG, Wu MJ. 2011. Antioxidant and anti-inflammatory activities of selected medicinal plants containing phenolic and flavonoid compounds. J. Agric. Food Chem. 59:12361-12367.