Remedial and Phytochemical Review Study on Tecoma Stans

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Abstract

The plant Tecoma stans belongs to family Bignoniaceae Juss.Tecoma stansis a destructive plant invader that outcompetes natural flora and grassland. It can be defined as a modifier species which decreases biodiversity and abolishes natural resources. It has been planted as an ornamental garden and street plant. It has wide range of therapeutic and pharmacological applications. Almost all parts (leaves, root, flower, seed, fruit, and bark) of the plant are reported for its remedial use. Tecoma stans is an herbal remedy used for treatment of diabetes, digestive problems, control of yeast infections, as powerful diuretic, vermifuge, anti-syphilitic, stomach pains and tonic. Preliminary phytochemical screening and isolation of this plant revealed the presence of tannins, flavonoids, phenols, anthraquinones, glycosides, alkaloids, quinones and traces of saponins and amino acids. This review article supports all updated data on its phytochemical and pharmacological actions and its traditional uses.

Keywords - *Tecoma stan, medicinal use, phytochemical Screening and isolation, allelochemicals, invasive shrub.*

I. INTRODUCTION

*Tecoma stans*is a shrub or a small tree which can attainheight up to of 8 m, rarely 10 m, and having stem diameters up to 25 cm. Plants in dense stands are normally smaller with heights (5-6m). It remains perennial in humid and warmer regions but changes to deciduous in more temperate areas with a marked dry season (Pelton, 1964). The pinnate leaves are bright green above, paler below and can be smooth or hairy, often around the veins, depending on the region (subspecies). The leaf size is also dependent on the variety and can be large, (100-200) mm long, pinnate with (3-17) leaflets (2.4-15) cm long, (0.8-6) cm wide, progressively larger distally (Gentry, 1992). Most leaves have (5-7) leaflets including the terminal one. Leaf margins can be sharply toothed or less toothed. Inflorescences are terminal or sub terminal with up to 20 bright yellow showy trumpet-shaped flowers, about 50 mm long. In some varieties the corolla is slightly orange-yellow with pinkish lines in the throat. The fruit is a linear shiny capsule, (12-22) cm long and about 1 cm thick, pointed at the end. The two-valve dehiscent capsule splits open to release up to 77 (mean 42) papery-winged seeds which are primarily wind, and to a lesser extent water, dispersed.The generic name is derived from the Mexican word for the plant, tecomnaxochitl, which means ‘vessel-flower’ and refers to the large, cup shaped or trumpet-shaped blooms. The specific name means ‘erect’ in Latin.Its chemical constituents arephytosterols, alkaloids, quinines, aminoacids, monoterpenes, triterpene, glycosides,phenols, flavonoids, saponins, andtannins. Studies have shown effectiveness as a diuretic, tonic, anti-syphilitic, and vermifuge. In traditional folk uses mostly roots are reported to be diuretic, tonic, anti-syphilitic and vermifuge. In Veracruz, decoction of flowers and bark are used for stomach pains.

II. LOCAL NAMES

English (ginger thomas, tecoma, trumpet flower, yellow bells,yellow bignonia,yellow cedar,yellow elder,yellow trumpet tree); French (Tecoma jaune,herbe de St. Nicholas,fleur de St. Pierre,chevalier); Arabic (tacoma); Creole (chevalye,flésenpié,zebsennikola); German (AufrechteTrompetenwinde); Italian (Tecomagiallo); Spanish (saúcoamarillo,roble amarillo); Tamil (sonapatti);Hindi (Piliya); Kannada (Koranekelar);Telugu (Pachagotla);Bengali(Chandaprabh); Marathi (Ghantiful); Nepali (Ghata Pushpa and Saawari).

III. SPECIES DISTRIBUTION

Native: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, French Guiana, Guatemala, Guyana, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Surinam, Uruguay, Venezuela.

Exotic: Benin, Burkina Faso, Cameroon, Chad, Cote d'Ivoire, Gambia, Ghana, India, Kenya, Liberia, Mali, Mauritania, Niger, Nigeria, Pakistan, Rwanda, Senegal, Sierra Leone, Sudan, Tanzania, Togo, Uganda, United States of America.

Fig 1. Distribution of Tecoma stans both in native and exotic range around the world.

The map above shows countries where the*Tecoma stans* species has been planted. It does neither suggest that the species can be planted in every ecological area within that country, nor that the species cannot be planted in other countries than those depicted. Since some tree species are invasive, you need to follow proper biosafety tools and methods that apply to your planting site.

IV. REPRODUCTIVE BIOLOGY AND SEED DISPERSAL

Where it occurs naturally, *Tecoma stans*is probably pollinated by humming birds. This plant produces abundant light and papery seeds that are primarily wind-dispersed. They may also be spread by flood waters and in dumped garden waste. This plant is auto compatible and requires external pollination (Kranz and Passini, 1997). It can flower throughout the year, or flowering can be seasonal, usually in summer and after good rains. Only a small proportion of the flowers set fruit in its native range which can be attributed to drought conditions, pollination failure and insect attack. In contrast, fruit set in countries of introduction is high, e.g. in South Africa. Vegetative reproduction from root and stem cuttings is less important for long distance dispersal but allows for rapid densification of populations after disturbances, including attempts to remove plants mechanically. The vigorous sucker shoots tend to be erect as the specific name 'stans' implies.

V. PARALLEL SPECIES

Yellow bells (*Tecoma stans*) is very alike to orange bells (*Tecomaalata*) and may also be confused with the garden plants known as golden trumpet vine (*Allamanda cathartica*) and shrubby allamanda (*Allamanda schottii*). It may be sometimes also confused with yellow oleander (*Cascabelathevetia*).

These species can be distinguished by the following differences.

Orange bells (*Tecomaalata*) have compound (pinnate) leaves that are oppositely arranged along the stems. These leaves have several toothed (serrated) leaflets and are borne on long slender stalks (petioles). Its moderately large (3-5 cm across) tubular flowers have reddish-orange outsides. Its fruit are usually long and with narrow capsules (10-30 cm long) that split open when mature to release numerous papery seeds.

Golden trumpet vine (*Allamanda cathartica*) has simple leaves that are clustered (whorled) along the stems. These leaves have entire margins and are borne on short stalks (petioles). Its flowers are very large (6-15 cm across) and its fruit are rounded and prickly (4-6 cm long) capsules that split open when mature to release abundant winged seeds.

Shrubby allamanda (*Allamanda schottii*) has simple leaves that are clustered (whorled) along the stems. These leaves have entire margins and are borne on short stalks (i.e. petioles). Its flowers are moderately large (3-6 cm across) and its fruit are rounded and prickly (4-6 cm long) capsules that split open when mature to release numerous winged seeds.

Yellow oleander (*Cascabelathevetia*) has simple leaves that are spirally arranged (densely alternately arranged) along the stems. These leaves are long and narrow (i.e. linear) with entire margins and obscure stalks (petioles). Its flowers are moderately large (4-6 cm across) and its fruit are large fleshy

drupes (25-55 mm across) that are somewhat rounded or slightly triangular.

Taxonomic hierarchy

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledonae
Order: Scrophulariales
Family: Bignoniaceae
Genus: Tecoma
Species: Tecoma stans

VI. PHYTOCHEMICAL STUDIES

Experimental studies of wani et.al (2014) callus induction studies and active components and antioxidant activity investigation from leaves and callus of *Tecoma stans L*. The phytochemical screening of the *Tecoma stans* plants varied according to the solvents used for the extraction of the leaves. Methanol and ethanol extracts of the leaves showed the presence of all the secondary metabolites studied- saponins, flavonoids, tannins, phenols, anthraquinones, alkaloids and glycosides which would be the active principles of the plant. Ethyl acetate extracts indicated the presence of saponins, tannins and phenols whereas aqueous extracts showed saponins, flavonoids phenols and alkaloids from leaves of *T. stans*. Anburaj et.al 2016 phytochemical screening and GC-MS analysis of ethanolic extract of *Tecoma stans* (Family: Bignoniaceae) revealed the presence of seventeen compounds (phytochemical constituents) which are shown in table 1.

s.no	Name of the compound
1	Propane, 1,1,3-Triethoxy-
2	5-Hydroxymethylfurfural
3	1'-Hydroxy-4,3'-Dimethyl-bicycl
4	9-Oxabicyclo[3.3.1]Nonan-2-One
5	1,10-Decanediol
6	1,2,3,4,7,7a-Hexahydro-2,4,7 Trimethyl-6H
7	Tropane, 2-Acetyl-2,3-Methylene-
8	5-Undecanol, 2-Methyl
9	6-Dodecanol
10	Silacyclopentane, 1,1-Dimethyl
11	Cyclobutanecarboxylic Acid, Decyl ester
12	Propanamide, 3-(1-Piperazinyl)-
13	Tetradecanoic Acid
14	Tetradecanoic Acid, Ethyl Ester
15	2(4h)-Benzofuranone, 5,6,7,7atetr
16	L-(+)-Ascorbic Acid 2,6-Dihexadecanoate
17	Hexadecanoic Acid, Ethyl Ester
18	N-Nonadecanol-1
19	9,12-Octadecadienoic Acid (Z,Z)
20	Ethyl (9z,12z)-9,12-Octadecadien
21	Octadecanoic Acid
22	N-Propyl 9,12-Octadecadienoate
23	9,12,15-Octadecatrienoic Acid, Ethyl Ester
24	Octadecanoic Acid, Ethyl Ester

25	Hexatriacontane

Table 2. shows the biological activities which are based on Dr. Duke's phytochemical and ethnobotanical databases created by Dr. Jim Duke of the agricultural research service/USDA 2013.

s.no	Name of the compound	Biological activity
1	Tetradecanoic acid	Antioxidant, Lubricant, Hypercholesterolemic, Cancer-preventive, Cosmetic
2	Hexadecanoic Acid, Ethyl Ester	Antioxidant, hypocholesterolemic, Anti androgenic, hemolytic, Alpha reductase inhibitor.
3	l-(+)-Ascorbic acid 2,6-dihexadecanoate	Vitamin C, Antioxidant, Immunomodulator
4	N-Nonadecanol-1	Antiinflammatory, Hypocholesterolemic, Cancer preventive, Hepatoprotective, Nematicide, Insectifuge Antihistaminic, Antiarthritic, Anticoronary, Antieczemic Antiacne, 5-Alpha reductase inhibitor Antiandrogenic,
5	9,12-Octadecadienoic Acid (Z,Z)-	Hypocholesterolemic, 5-Alpha reductase inhibitor, Antihistaminic, Insectifuge, Antieczemic, Antiacne
6	9,12,15-Octadecatrienoic Acid, (Z,Z,Z)	Hypocholesterolemic, Nematicide Antiarthritic, Hepatoprotective, Anti androgenic, Nematicide 5- Alpha reductase inhibitor, Antihistaminic Anticoronary, Insectifuge, Antieczemic Anticancer
7	Octadecanoic acid	Cosmetic, Flavor, Hypocholesterolemic, Lubricant, Perfumery, Propecic, Suppository

Table 3: Detection of chemical constituents of*Tecoma stan* analyzed usingdifferent extracts.

		Extracts		
Componentes	Tests/Reagents	Aqueous	Ethanolic	n-Hexane
Alkaloides	Wagner	+	+	+
Coumarines	NaOH	+	+	+
Flavonoides	Salkowski	+	+	+
Sesquiterpenlactons	Baljet	+	+	+
Esteroles and metilesteroles	Liebermann-Burchard	_	+	+
Carbohydrates	Molisch	+	_	_
Saponines	Liebermann-Burchard	_	+	+
Quinones	Borntrager	_	+	_
Insaturaciones	KMnO4	+	+	_

- The constituent was not found
+ The constituent was present

VII. REMEDIAL USES

Traditional uses-almost all the parts ofplant are of medicinal importanceand used traditionally for the cure ofvarious diseases. South America and LatinAmerica used traditionally for reducingblood glucose. The *Tecoma stans* leaves,barks and roots have been used for avariety of purposes in the field of herbal medicine.Bark shows smooth muscle relaxant, mild cardio tonic and chlorotic activity. Applications include the experimental treatment of diabetes, digestive problems, control of yeast infections and other medicinal applications. It contains several compounds that are known for their catnip likeeffects on felines. The root of the plant is reported to be a powerful diuretic, vermifuge and tonic. A grinding of the root of *Tecoma stans* and lemon juice is reportedly used as an external application and also taken internally in small quantities as a remedy for snake and rat bites.

VIII. PHARMACOLOGICAL ACTIONS

A. Antioxidant Activity

Alma R et.al 2009. reported antioxidant activity and both phenolic compound and flavonoid total content were determined for callus tissue of *Tecoma stans*cultured in either a set photoperiod or in darkness. Results of the present study show that calli of *Tecoma stans*are a source of compounds with antioxidant activity that is favored by culture under a set photoperiod.

B. Anti-Inflammatory Activity

Sawapna Chaudhary 2009 evaluated the anti-inflammatory activity of chloroform root extract of *Tecoma stans*. Chloroform extract was analyzed for anti-inflammatory activity against carrageenan-induced paw edema method in Wistar albino rats. In control group simple distilled water, in standard group Aspirin (100 mg/kg) and in test groups chloroform extract (100mg/kg, 200mg/kg) were administered orally. After 30 minutes, 1% w/v carrageenan solution was injected intraperitoneally, and the paw volume of control, standards and test groups were noted at 1hr, 2hr, 3hr and 4hr time interval. Anti-inflammatory effects of the extracts showed significant anti-inflammatory activity at 200mg/kg (% of inhibition of paw edema 50.93 at 4 hrs.) as compared to control.

C. Cardio-protective effect

Cardiovascular diseases cause death in many countries. Myocardial infarction is the imbalance oxygen supply to the myocardium followed by the development of myocardial necrosis. This causes increase in the toxic reactive oxygen species such as O2-, H2O2, OH-etc. exerts simple oxidative pressure on myocardium prompting to CVD (Cardiovascular diseases), like, ischemic heart disease, atherosclerosis, congestive heart. The *Tecoma stans*are having the cardio protective effect which is screened by the animal model an estimation of the antioxidant activities of the myocardium.

D. Cytotoxicity study

Cytotoxicity is toxic to cells. The cytotoxicity of *Tecomastans* in human hepatoblastoma was determined by incubating the cells up to 72-hours and changingwithconcentrations of herbal extracts. Toxic effects of *Tecomastans* were originated to be attentiveness and time-dependent in the presence and absence of fetal bovine serum.

E. Antidiabetic Activity

Leaf extracts of *Tecoma stans* is widely used as a traditional antidiabetic therapy in Mexico. Tecomine was shown to be one of the compounds responsible for the hypoglycemic action. Aguilar-Santamaria et.al assessed in vivo and in vitro intestinal α-glycosidase inhibition as the potentialmethod of action of tecoma aqueous leaf extract on type 2 diabetes mellitus (DM2) animal models. The intravenous administration of *Tecoma stans* infusion in normal dogs produces an early hyperglycemic response and arterial hypotension followed by a slow decline of the glucose blood values with a concomitant hypertriglyceridemia, but no important changes in immunoreactivity insulin were detected. Heart frequency was gradually increased after the first 60 min of drug administration and persisted for several hours. The effects observed on blood parameters seem to be related to hepatic glycogen metabolism, involving an activation of glycogenolysis. The late hypoglycemic effect of *Tecoma stans* infusion could be considered secondary to the observed hepatic glucose output. The study represents an attempt to elucidate the popularly attributed antidiabetic properties of this Mexican medicinal plant.

F. Antimicrobial Activity

The methanol extracts of the leaves and stem bark of *Tecoma stans* was studied for their antimicrobial activity using a wide range of gram-positive and gram-negative bacteria and fungi. Methanol extracts of *Tecoma stans* leaves was found to be effective against only *Candida albicans*. It was detected that the extracts of stem bark generally showed better antimicrobial activity than those of the leaves and some organisms were selectively more sensitive to the extracts than others.

G. Antispasmodic Activity

M.K. garibnaseri et.al 2007examined the effect of*Tecoma stans* leaf extracts on rat ileum contractility and involved mechanism. *Tecoma stans*hydro alcoholic

leaf extract (TLE) was prepared by maceration method using 70% alcohol. Distal segment of ileum (2 cm) from male Wistar rat was mount in an organ bath Containing Tyrode solution (10 ml, pH 7, 37 °C) and pre-contracted by carbachol (CCh, 10 μM) or by KCl (60 mm). The antispasmodic effects of TLE (0.125–2 mg/ml) were studied prior and after 20-30 min incubation of ileum with propranolol (1μM), naloxone (1μM), LNAME(100μM), or 5 min incubation with glibenclamide (10 μM) and tetraethyl ammonium (TEA, 1mm). The effect of TLE on CaCl2-induced contraction in Ca2+- free with high K+ Tyrode solution was also studied.TheCChandKCl-induced ileal contractions were reduced by TLE ($P<0.0001$). This effect was not attenuated by propranolol, naloxone, LNAME, glibenclamide and TEA. In Ca2+- free tyrode solution with high K+, cumulative concentrations of CaCl2 induced contractions which were inhibited by TLE dose dependently. Our results indicate that the *Tecoma stans*leaf extract induces its antispasmodic effects without involvement β-adrenoceptors, opioid receptors, potassium channels and NO production. It seems that, the calcium channels are involved in this spasmolytic effect.

H. Wound healing activity

C. Das, S.Dash, D.C Sahoo 2010A. estimated the methanolic bark extract of *Tecoma stan*linn for wound healing activity in albino rats. Wound healing practices are well controlledbiochemical and cellular events leading to the growth and regeneration of wound tissue in a special manner. Healing of wounds involves the activity of an intricate network of blood cells, cytokines, and growth factors which ultimately leads to the restoration to normal condition of the injured skin or tissue. The aim of wound care is to promote wound healing in the shortest time possible, with minimal pain, discomfort, and scarring to the patient and must occur in a physiologic environment conducive to repair and regeneration. Wound healing activity of *Tecoma stans*was studied and the results suggest that local application and systemic administration of methanol extract of the bark has shown more significant wound healing activity in excision and incision wound models and support the popular use of plant to open wound in folk medicine. The presence of phytoconstituents like phytosterol, triterpene, glycosides, phenols, flavonoids, saponins, and tannins either individually or combined may exhibit the synergistic effect towards healing of wounds.

I. Anti-Proliferative

ActivityCancer isan awful sicknesswhich ismore than 100 different types and is categorized by uneven proliferation of the cells which required multidimensional approach for its treatment, control, prevention and is a second leading cause of death worldwide. Breast cancer is one of the long-lasting ailments which may familiarity by females (32.1%) throughout her lifetime and is most commonly identifiedcancer in them. (Indra et.al The invitroantiproliferative activity of the various parts of the *Tecoma stans*is done in the Breast cancer-MCF-7cell linesby MTT assay. The Stem,Root, Bark and flowers extracts showed significant anti-proliferative action on the cell lines (MCF-7) but extreme action was found to be in extractstem bark of *Tecoma stans*.

IX. RISK AND IMPACT FACTORS OF TECOMA STANS

Invasiveness: Invasive in its native range, proved invasive outside its native range, highly adaptable to different environments, Tolerates or benefits from cultivation, browsing pressure, mutilation, fire etc,highly mobile locally, has high reproductive potential, has propagules that can remain viable for more than one year.

Impact outcomes: Damaged ecosystem services, Ecosystem change/ habitat alteration, negatively impacts agriculture, negatively impacts tourism, reduced amenity values, reduced native biodiversity.

Impact mechanisms: Competition-monopolizing resources, Competition-smothering, Pest and diseasetransmission.

Likelihood of entry/control: Highly likely to be transported internationally deliberately, Difficult/costly to control.

X. PREVENTION AND CONTROL

Integrating various control methods is the most effective approach and includes the prevention of new introductions, dispersal and sales by the nursery trade as well as mechanical and chemical control.

Mechanical Control: Maintaining a vigorous ground cover, preventing overgrazing and rehabilitating disturbed areas remains one of the best methods to prevent establishment and invasion of *Tecoma stans*. Frequent inspections of pastures and forest margins are necessary to locate seedlings that can be hand-pulled. Larger plants can be uprooted by using a tractor, but resprouting from cut roots can cause rapid reinfestation unless the remaining roots are burnt after drying. Rehabilitation of such disturbed areas after uprooting and burning is essential. Follow-up control to remove the regrowth is necessary for at least a year after initial control (Kranz and Passini 1996, 1997).

Chemical Control: Conventional chemical control methods of shrubs and small trees as practised by most municipalities and counties are not effective against T. stans. Only repeated applications of foliar-applied

herbicides are effective, but this method is usually not economic. More effective are cut-stump application methods using oil-based or oil/water emulsions of 2,4-D and picloram mixtures. These are generously applied to the freshly cut stumps by spraying or painting. Soil applied tebuthiuron also gave excellent control 270 days after treatment (Kranz and Passini, 1997).

Biological Control: Host specificity tests on two rust fungus species, namely, the micro cyclic Prospodium transformans and the macro cyclic P. appendiculatum from Mexico are in progress in South Africa. P. appendiculatum is already present in Brazil and Argentina but is not contributing much to the suppression of populations. Further surveys for additional host-specific natural enemies are planned. A raceme-feeding membracid and the pyralid pod-feeding moth Clydenopteron sp. are to be introduced into quarantine in South Africa for possible biological control.

XI. CONCLUSION

Tecoma stans is rich in allelochemicals but is widely used as a traditionalantidiabetic remedy in Maxico. Literaturesurvey shows wide spectrum ofpharmacological activities as well as the allelopathic nature of *Tecoma stan*.*Tecoma stans*are having the many of the active phyto constituents which leads to the great medicinal value of this plant. In this review it was concluded that the various part of the plants are having various pharmacological actions like anti-inflammatory, analgesic,anticancer cardio-protective effect, genotoxic, cytotoxicity, wound healing, anti- hyperglycemic, protect CNS, gastric ulcer healing, antiproliferative, antioxidant, anti-microbial, hemolytic activity, anti-lipoxygenaseand acetyl-cholinesterase inhibitory activities. However, furtherinvestigation employing isolation ofconstituents and screening models areneeded for further confirmation of woundhealing potential as well as the extraction of exact bioactive compound present in *Tecoma stans* which could be potentially used in weed management.

REFERENCES

[1] Pelton, J 1964. A survey of the ecology of Tecoma stans," Butler Uni. Bot. Stud.14(2):53:88.

[2] Gentry AH, 1992. Bignoniaceae Part II (Tribe Tecomeae). Flora Neotropica. New York, USA: New York Botanical Garden, 285-290.

[3] Kranz WM, Passini T, 1996. Fenologia de Tecoma stans (L.) Kunthcomosubsidio para seucontrole. In: Congresso da Sociedade Botanica de Sao Paulo, 11. Sao Carlos. Proceedings, 103-104.

[4] Kranz WM, Passini T, 1996. Tecoma stans (L.) Kunth (Bignoniaceae), planta invasora de pastagens no Estado de Parana. In: Congreso Nacional de Botanica, 42, Novo Friburgo, 1966. Proceedings, 315.

[5] Kranz WM, Passini T, 1997. Amarelinho, biologia e controle. Informed a Pesquisa. Estado do Parana, Secretaria da Agricultura e do Abastecimiento, Instituto Agronomico do Parana, No. 121:1-17.

[6] Gharib Naseri MK., Asadi Moghaddam M, Bahadoram S. 2007. Antispasmodic effect of Tecoma stans (L.) Juss leaf extract on rat ileum, DARU, 15(3):123-28.

[7] Chaudhary S.2009. Cellular and molecular immunology & immunotherapy. 37-9

[8] Dr., Duke,2009. J. Duke's Phytochemical and Ethnobotanical Databases. http://www.ars-grin.gov/duke/plants.html.

[9] Alma R. Lopez-Laredo Fanny D. Ramirez-Flores Gabriela Sepulveda-Jimenez Gabriela Trejo-Tapi, 2009. Comparison of metabolite levels in callus of Tecoma stans (L.) Juss. Ex Kunth. cultured in photoperiod and darkness. In Vitro Cell.Dev.BioL-Plant: 45:550-558

[10] Das C., Dash S., Sahoo D. C., Mohanty A.2010.Evaluation of methanolic bark extract of Tecoma stan linn, for wound healing in albino rats. International Journal of Pharmacy & Technology. Volume II, 735-42.

[11] MinalWani and Namde H. 2014. Callus induction studies and active components and antioxidant activity investigation from leaves and callus of Tecomastans (L.) Juss.ExKunth. RJPBCS., 5(2):604-610.

[12] Anburaj G., Marimuthu M. and Manikandan R. 2016. In vitro antimicrobial activity of aqueous and Ethanol extracts of Tecoma stans bark against pathogenic Bactria; International Recent Research Journal on Science and Technology; Vol. 8 No. 2; 26-283.

[13] Anburaj G., Marimuthu M., RajasudhaV. and Manikandan R. 2016. Phytochemical screeningand GC-MS analysis of ethanolic extract of Tecoma stans (Family: Bignoniaceae) Yellow Bell Flowers; Journal of Pharmacognosy and Phytochemistry; Vol. 5 No. 4; 172-1754.

[14] Anburaj G., Marimuthu M.,Sobiyana P. and Manikandan R. 2016. A Review on Tecoma stans; International Journal of Engineering Research and Modern Education.1(1): 43-49.