Review Article

Review on Genus *Canthium*: Special Reference to *Canthium coromandelicum* – an Unexplored Traditional Medicinal Plant of Indian Subcontinent

Sanjeeb Kumar Patro[1], D. Sasmal*[1], Papiamitra Mazumndar[1], Padmacharan Behera[1] Uma Ranjan Lal[1], S. K. Dash[2] and Ranjan Kumar Padhy[2]

[1]Department of Pharmaceutical Sciences, Birla Institute Technology, Mesra, Ranchi-835215
[2]College of Pharmaceutical Sciences, Bramhapur (Mohuda), Ganjam, Odisha-760002

Address for Correspondence

Department of Pharmaceutical Sciences, Birla Institute Technology, Mesra, Ranchi-835215
E-mail: dsasmal@bitmesra.ac.in

ABSTRACT

The medicinal plants are widely used by the traditional medical practitioners for curing various diseases in their day to day practice. *Canthium coromandelicum* (Rubiaceae) is one of traditional medicinal plant in India which is used for treatment of various ailments. Different parts of plants (ie., leaves, bark, stem, fruits, root and even whole plant) have shown to have various pharmacological activities like antimicrobial activity, antioxidant activity , hepatoprotective activity, antimalarial activity, anti-diabetic activity, anti asthmatic and antibacterial Activity. Phytochemicals reported in the plants have been listed based on their pharmacological activity. Although Phytopharmacological reports are very less, still it is considered as a valuable source of treatment against various diseases. The present review highlights a literature on botanical, chemical and pharmacological discussion of *Canthium coromandelicum.*

Keywords: *Canthium coromandelicum, Phytoconstituents, Phytopharmacology, Indian medicinal plant.*

INTRODUCTION

A large proportion of the population in many developing countries relies on traditional herbal practioners to meet their primary health care needs. Amidst wide range of availability of modern i.e. synthetic medicines, herbal medicines more appropriately the herbal drugs or herbals often retain their popularity for their intense historical and cultural values. These herbals and their isolated compounds i.e. the bio-active principles, have demonstrated spectra of biological activities. Therapeutic data on such herbals are much comprehensive from the medico folk lore literatures of many regions as recorded from time to time. In view of the increasing demand of these herbal drugs, the issues regarding their safety, efficacy and

quality maintenance in industrialized and developing countries as well are cropped up.

Description of the Plant from existing literature

Canthium coromandelicum (Burm.f.) Alston. (Syn.*C. parviflorum*) of Family: Rubiaceae is a bushy thorny suffruticose herb, native of India found mainly in coromandelicum region. The plant is popularly recorded under the local name ie in Odisha "**Tutidi saga"** (odia language).

Canthium coromandelicum is native to India, Sri Lanka, and tropical East Africa (Bridson DM 1992). *Canthium Coromandelicum* is a shrub, usually with opposite horizontal thorns a little above the leaf axils. However, sometimes the shrub is nearly unarmed. Leaves are ovate, smooth, and often fascicled on young shoots. Short, few flowered racemes arise in leaf axils. Flowers are small, yellow with 4 stamens. Flowers are bearded in the throat. Tube is short, with 4-5 spreading petals. Anthers are inserted into the throat, scarcely protruding. Style protrudes out. Stigma is somewhat spherical. Fruits are obovate, furrowed on each side. Flowering season of plant is from July-August. Fruits are red or brown, dark pinky when ripe.

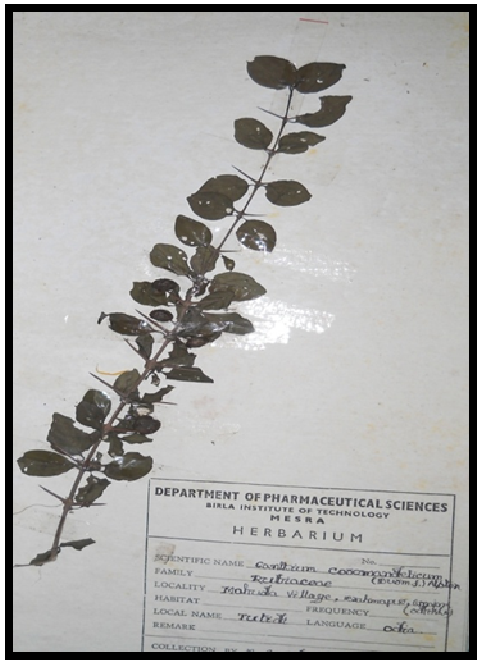
Canthium genus was named by Jean-Baptiste Lamarck in 1785 in Encyclopédie Méthodique (Lamarck J-B 1785). The name is a latinisation of "*kantankar*", a Malayalam name from Kerala for *Canthium coromandelicum*. *Kantan* means "shining" and *kara* means "a spiny shrub" (Quattrocchi U 2000). The biological type for the genus consists of specimens originally described by Jean-Baptiste Lamarck as *Canthium parviflorum* (*Canthium* In: Index Nomenum Genericorum) but this species is now included in *Canthium coromandelicum* (Bridson DM 1992). *Canthium* is a member of Vanguerieae, a tribe that is monophyletic and easily recognized morphologically, but in which generic boundaries were, for a long time, very unclear (Lentz *et al*., 2005). Identification of *Canthium* was difficult till 1980s, as it was defined broadly and known to be polyphyletic. Psydrax was separated from it in 1985 (Bridson DM 1985), as was Keetia in 1986 (Bridson DM 1986). These were followed by Pyrostria and Multidentia in 1987 (Bridson DM 1987). The subgenus Afrocanthium was raised to generic rank in 2004(Lentz *et al*., 2004) followed by Bullockia in 2009 (Razafimandimbison *et al*., 2009). A few species were transferred to *Canthium* from *Rytigynia* and other genera in 2004 but the final circumscription of Canthium will remain in doubt until phylogenetic studies achieve greater resolution for the clad containing *Canthium coromandelicum* and its closest relatives (Lentz *et al*., 2004).

Synonyms

Canthium parviflorum, *Plectronia parviflora, Paederia valli-kara, Webera tetrandra*

Taxonomical/Scientific classification

Kingdom:	Plantae
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Gentianales
Family:	Rubiaceae
Subfamily:	Ixoroideae
Tribe:	Vanguerieae
Genus:	*Canthium*
Species:	*Coromandelicum*



Vernacular names

English**:**	Coromandel Canthium
Marathi:	Kirma, Kadbar
Malayalam:	Kantankara, Niruri, Serukara
Telugu:	Sinnabalusu, Balusu
Kannada:	Karemullu, Ollepode
Oriya:	Tutidi
Konkani:	Kayili
Sanskrit:	Nagabala, Gangeruki in Keesara, Rangareddy district, Andhra Pradesh.
Tamil:	Mullukaarai, Nallakkarai, Theravai, Theranai, Karay chedi, Kudiram, Sengarai.

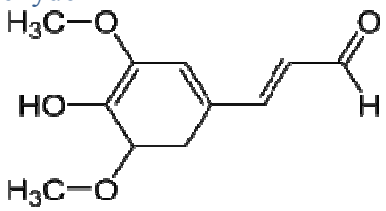
Ethnomedicinal Claims

The plant parts having various ethnomedicinal uses. These are listed in table: See Table No. 1

Phytochemical investigation

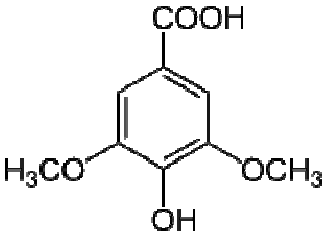
Phytochemical studies carried out on Canthium coromandelicum and its allied species have reported the identification of some phyto constituents like: See Table No. 2

Sinapaldehyde



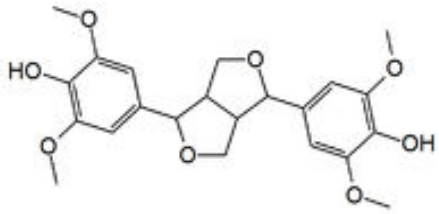
3-(4-Hydroxy-3,5-dimethoxyphenyl)prop-2-enal

Syringic acid



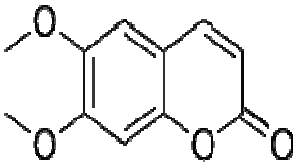
4-hydroxy-3,5-dimethoxybenzoic acid

Syringaresinol



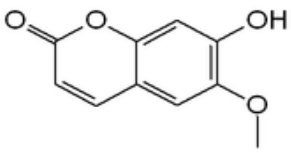
4,4'-(1S,3aR,4S,6aR)-Tetrahydro-1H,3H-furo [3,4-c]furan-1,4-diylbis(2,6-dimethoxyphenol)

Scoparone



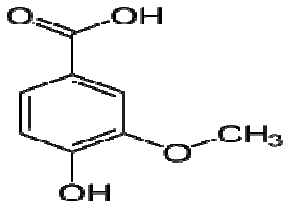
6,7-Dimethoxy-2*H*-chromen-2-one

Scopoletin



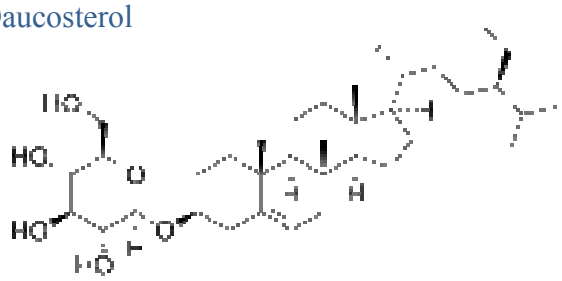
7-hydroxy-6-methoxychromen-2-one

Vanillic acid



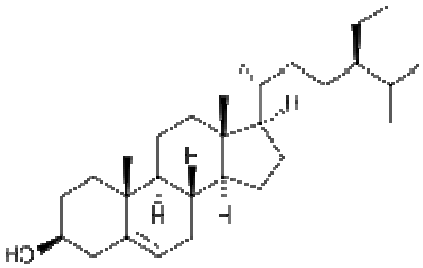
4-Hydroxy-3-methoxybenzoic acid

Daucosterol



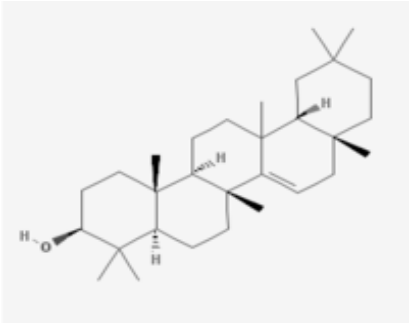
Lyoniside, Daucosterol, Sitogluside, Eleutheroside A, Alexandrin, 17-(5-Ethyl-6-methylheptan-2-yl)-10,13-dimethyl-Coriandrinol, Daucosterin, *beta*-Sitosterol glucoside

beta-Sitosterol



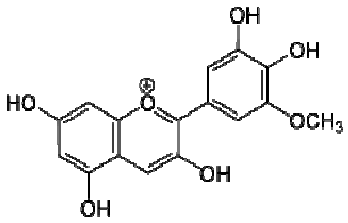
4,4,6a,6a,8a,11,11,14b-octamethyl tetradecahydropicen-3-ol
2,3,4,7,8,9,11,12,14,15,16,17-dodecahydro-1*H*-cyclopenta[*a*]phenanthren-3-ol

Taraxero



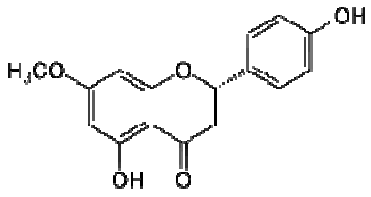
(3*S*,4a*R*,6a*R*,6a*S*,8a*R*,12a*R*,14a*R*,14b *R*)- -1,2,3,4a,5,6,8,9,10,12,12a,13,14,14a-

Petunidin



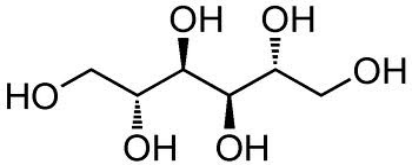
2-(3,4-dihydroxy-5-methoxyphenyl)-3,5,7-trihydroxychromenylium

Sakuranetin



(2*S*)-5-hydroxy-2-(4-hydroxyphenyl)-7-methoxy-2,3-dihydrochromen-4-one

D- Mannitol



Canthium species

- *Canthium aciculatum*
- *Canthium angustifolium* Roxb.
- *Canthium approximatum* Korth.
- *Canthium arboreum* Vidal
- *Canthium aurantiacum* Merr. & L.M.Perry
- *Canthium bakerianum* Drake
- *Canthium berberidifolium* Geddes
- *Canthium bipinnatum* (Blanco) Merr.
- *Canthium brunneum* (Merr.) Merr.
- *Canthium calvum* Craib
- *Canthium cambodianum* Pit.
- *Canthium campanulatum* Thwaites
- *Canthium carinatum* (Baker) Summerh.
- *Canthium cavaleriei* H.Lév.
- *Canthium ciliatum* (D.Dietr.) Kuntz
- *Canthium coffeoides* Pierre ex Pit.
- *Canthium confertum* Korth.
- *Canthium congestiflorum* Ridl.
- *Canthium cordatum* Dillwyn
- *Canthium coromandelicum* (Burm.f) Alston
- *Canthium culionense* (Elmer) Merr.
- *Canthium depressinerve* Ridl.
- *Canthium ellipticum* (Merr.) Merr.
- *Canthium elmeri* Merr.
- *Canthium fenicis* (Merr.) Merr.
- *Canthium ferrugineum* Craib
- *Canthium filipendulum* Pierre ex Pit.
- *Canthium fraternum* Miq.
- *Canthium glabrum* Blume
- *Canthium glandulosum* (Blanco) Merr.
- *Canthium glaucum* Hiern
- *Canthium gracilipes* Kurz
- *Canthium gynochthodes* Baill.
- *Canthium hebecladum* DC.
- *Canthium hirtellum* Ridl.
- *Canthium hispidonervosum* (De Wild.) C.M.Evrard
- *Canthium homolleanum* Cavaco
- *Canthium horridulum* Craib
- *Canthium horridum* Blume
- *Canthium inerme* (L.f.) Kuntz
- *Canthium korthalsianum* Miq.
- *Canthium kuntzeanum* Bridson
- *Canthium laeve* Teijsm. & Binn.
- *Canthium lasianthoides* Miq.
- *Canthium leytense* (Merr.) Merr.
- *Canthium libericum* Dinkl.
- *Canthium longipes* Geddes
- *Canthium lucidum* R.Br.
- *Canthium macrocarpum* Thwaites
- *Canthium megacarpum* (Merr.) Merr.
- *Canthium megistocarpum* Merr. & L.M.Perry
- *Canthium merrillianum* Mabb.
- *Canthium merrillii* (Setch.) Christoph.
- *Canthium mite* Bartl. ex DC.
- *Canthium molle* King & Gamble
- *Canthium moluccanum* Roxb.
- *Canthium monstrosum* (A. Rich) Merr.
- *Canthium neilgherrense* Wight
- *Canthium oblongifolium* Quisumb. & Merr.
- *Canthium oblongum* (Valeton) Kaneh.
- *Canthium obovatifolium* (Merr.) Merr.
- *Canthium oliganthum* (Miq.) Boerl.
- *Canthium oligocarpum* Hiern
- *Canthium oligophlebium* (Merr.) Merr.
- *Canthium parvifolium* Roxb.
- *Canthium paucinervium* (Merr.) Merr.
- *Canthium pedunculare* Cav.
- *Canthium perakanthus* ined.
- *Canthium polyanthum* Miq.
- *Canthium puberulum* Thwaites ex Hook.f.
- *Canthium quadratum* Craib
- *Canthium ramosii* (Merr.) Merr.
- *Canthium rheedei* DC.
- *Canthium sarcocarpum* (Merr.) Merr.
- *Canthium sarmentosum* Craib
- *Canthium scabridum* Ridl.
- *Canthium scandens* Blume

- *Canthium schlechterianum* Merr. & L.M.Perry
- *Canthium sechellense* Summerh.
- *Canthium siamense* (Harms) Pit.
- *Canthium simile* Merr. & Chun
- *Canthium sordidum* (K.Schum.) Bullock
- *Canthium spinosissimum* Merr.
- *Canthium spinosum* (Klotzsch ex Eckl. & Zeyh.) Kuntz
- *Canthium spirostylum* Miq.
- *Canthium stellulatum* Craib
- *Canthium strigosum* Craib
- *Canthium strychnoides* Craib
- *Canthium subaureum* Craib
- *Canthium subcapitatum* (Merr.) Merr.
- *Canthium suberosum* Codd
- *Canthium subsessilifolium* (Merr.) Merr.
- *Canthium sumatranum* Miq.
- *Canthium tavoyanum* (R.Parker) Merr.
- *Canthium travancoricum* Bedd.
- *Canthium trichophorum* Quisumb. & Merr.
- *Canthium umbelligerum* Miq.
- *Canthium vanwykii* Tilney & Kok
- *Canthium villarii* Vidal
- *Canthium violaceum* Zoll. & Moritzi
- *Canthium wenzelii* (Merr.) Merr.

Canthium coromandelicum
Source: wikimedia.org

PRECLINICAL PHARMACOLOGICAL EVALUATIONS

See Table No. 3

The various pharmacological activities as imbibed from the literatures are accounted as fallows (2013).

A. Wound healing and diuretic activities

Maohideen S *et., al.* 2003 reported that the aqueous extract of cc had showed the significant incision and excision wound healing activity on as evidence by increased rate of wound contraction as compared with the control group. The 10% w/w of aqueous extract ointment exhibited equivalent wound healing activity as compared to Nitrofurazone ointment. Significant diuretic activity was exhibited by the extracts. Graded responses for both the activities were observed for extracts.

B. Antifungal activity

K Subramanian *et al*., (2004) was reported that certain Flavonol glycosides and phenolic acid from *Canthium* species produce anti fungal activity. The antifungal activity of six Flavonol glycosides and two phenolic acids isolated from *Canthium* spp. of Rubiaceae is presented.

C. Evaluations of antioxidant properties

Satish Kumar T. *et al*., (2008) was reported evaluation of antioxidant properties of *Canthium parviflorum* Lam. Leaves. Ethanolic extract of *C. parviflorum* leaves was analyzed for their total antioxidant capacity, reducing power, metal chelating, $ABTS^{+}$ [2, 2 –azinobis-3-ethylbenzothiazolin-6-sulphonate] radical scavenging and hydroxyl scavenging activities. The extract at 500µg/ml showed maximum scavenging activity (51.60%) of ABTS radical cation followed by the iron chelation (45.12%) at the same concentration. However, the extract showed only moderate hydroxyl radical scavenging activity (6.42%). Total antioxidant capacity was found to be 12.9 mg ascorbic acid equivalents at 500µg/ml extract concentration. There was positive correlation

between the total phenolic content and antioxidant capacity, $R^2 = 0.8313$, whereas the correlation between the total flavonoids and antioxidant capacity was determined to be $R^2 = 0.8102$. The results suggest that phenolics and flavonoids in the leaves provide considerable antioxidant activity.

D. Oral hypoglycaemic activity

Rahal Widanagamage *et al.* (2009) was reported oral hypoglycaemic activity of the leaf extract in rats. Percentage decreases of serum glucose levels of 15.4 % - 25.7 % were observed at doses of 15-30 g/ kg body weight following a glucose challenge. This is indicative of acute hypoglycaemic (anti-hyperglycaemic) activity of the leaf extract. Oral glucose challenge on the 8th and 15th day following repeated administration of leaf extract (20g/kg body weight) for 7 and 14 days did not suppress the fasting or the post-prandial serum glucose levels. It is concluded that the observed acute hypoglycaemic (anti-hyperglycaemic) effect is possibly due to inhibition or reduction of intestinal glucose absorption mediated by soluble dietary fibre (SDF; 1.2% DM) and pectin (38% of SDF) in the leaf. This will explain the absence of a chronic effect. This study provides evidence for its traditional recommendation as a functional food in diabetes.

E. The hypocholesterolaemic activity

Bandara W V R T D G *et al.* (2009) was reported that hypocholesterolaemic effect on Wistar rats which is due to high molecular weight pectin (up to 2 million Daltons) as determined by Sepharose (2B) gel chromatography and present in a content of 1.8-3.4% on dry weight. Together with its mild hypoglycaemic effect reported previously its hypocholesterolaemic effect is now hypothesized to be due to the effect of high molecular weight pectin. It is postulated that the leaf would make a good functional food.

F. *In vivo* evaluation of potential nematocidal activity

Wabo Pone *et al.*, (2009) were reported that *In vivo* evaluation of potential nematocidal properties of ethanolic extracts of *Canthium mannii* (Rubiaceae) on Heligmosomoides polygyrus parasite of rodents. The nematocidal activity of ethanol extract of Canthium mannii was assessed *invivo* to that of Mebendazole on the adult of Heligmosomoides polygyrus.105 Swiss white mice of two sexes aged 5-6 week old, and weighing between 20 and 25 gm were orally infected with a 0.8 ml of a dose of 104-120, 1 week old H. polygyrus infective larvae (L3). After pre-patent period (9-11 days), infected animals were randomly divided into 7 groups of 15 animals each. The nematocidal efficacy of the ethanolic extract was monitored through faecal egg count (FEC) reduction and total worm count (TWC) reduction. 5 doses (350, 700, 1400, 2800 and 5600mg/mg body Weight) for ETE and 22mg/kg for Mebendazole were studied using a bioassay. Mebendazole and 3% DMSO were included in the assays as reference drug and placebo respectively. Each host received according to its weight for 7days a daily dose 0.7ml of the product. The ETE for all the doses tested except the dose that 350mg/kg body weight was active *in vivo* on the adult of H. polygyrus and reduced significantly ($p<0.05$) the FEC and the TWC of the nematode. The dose rate 5600mg/kg body weight showed the highest nematocidal activity of 75%FECR and 83.6% TWC reduction 7 days post treatment. These results supported the possible use of medicinal plants in the control of Gastro intestinal helminthiasis.

G. Antibacterial activity

P. Sathiya Priya *et al*,.(2009) was reported that the methanol extract of *Ruta chalapensis* (L), *Quercus infectoria* (Oliver) and *Canthium parviflorum* (Lam) against Staphylococcus aureus, Pseudomonas

aeruginosa, Enterococcus faecalis, Klebsiella pneumonia and Proteus mirabilis. The experiment was carried out using disc diffusion method. The results revealed that the methanol extract of aerial parts of Canthium parviflorum showed significant zone of inhibition.

H. *In vitro* antiplasmodial and antibacterial activities

Akomo E F O *et al*., (2009) was reported *In vitro* antiplasmodial and antibacterial activities of *Canthium multiflorum* schum and Thonn (Rubiaceae) extracts. The antiplasmodial activity was performed on fresh clinical strains of Plasmodium falciparum using light microscopy. The result revealed that the methanol extract was the most active with IC50 of 4.69µg/ml. The NCCLS micro dilution method performed on clinical reference strains of pathogenic bacteria yielded MIC and MBC values ranging from 312 to 1250 and 625 to 2500 µg/ml, respectively. The qualitative analysis of the extract revealed the presence of several chemical groups such as alkaloids, terpens, and tannins that might be responsible for the activity of the plant. The issue of this study showed that *C. multiflorum* is a plant much attention should be paid to because of its pharmacological potentials.

I. Chemical constituents and antimicrobial activities

Yong Biao *et al*., (2010) was reported Chemical constituents and antimicrobial activities of *Canthium horridum*. Bioassay-guided isolation studies of the extract of *Canthium horridum* BI. Stem led to the isolation of ten compounds: (+)-Syringaresinol, scoparone, 3'-methoxy-4'-hydroxy-trans-cinnamaldehyde, sinapic aldehyde, syringic acid, mannitol, vanillic acid 4-0- β -D-glucopyranoside, β -daucosterol, β-sitosterol. All the ten compounds were reported first time from this species and compounds 1, 4, 5, 6, and 8 from the genus. The antimicrobial activities of the isolated compounds were studied; 6 had the highest activity against Bacillus subtilis, but 1 showed good activity against Escherichia coli, Bacillus subtilis, and Staphylococcus aureus. Compounds 2, 4, and 6 also inhibited the growth of these three bacteria. None of the compounds demonstrated inhibitory activity against Aspergillus niger.

J. *In vitro* nematocidal activities

Wabo Pone *et al*., (2010) were reported that the extracts of *Canthium mannii* (Rubiaceae) on different life-cycle stages of Heligmosomoides polygyrus parasite of rodents. The potential nematocidal activities of four extracts from the bark of Canthium mannii (Rubiaceae) stems were investigated *In vitro*. Extracts were diluted in distilled water to obtain five different concentrations (1.5, 2.0, 2.5, 3.0 and 3.5 mg/mL) and put in contact with eggs and larvae of Heligmosomoides polygyrus. The different stages of the life cycle were also put in contact with the same concentration of Mebendazole (MBZ, pos. control). One mL of each ext. at different concentrations, and control were added to 1ml solution containing 30-40 eggs or 10-15 larvae (L1, L2, and L3) and distributed in different Petri dishes. The eggs and larvae were incubated at 24^{o} and exposure times were: 48 hrs for un-embryonated eggs, 6 hrs for embryonated eggs; 2, 4, 6, and 24 hrs for L1 and L2 larvae, 24-48 hrs for infective larvae (L3), and 5 days for the larval developmental test (from L1 to L3). DW and DMSO were used as placebo and 1% DMSO control, respectively. Significant effects were obtained with 3 of 4 extracts, and differences were observed depending on parasite stage. Cold water extract, hot water extract, and ethanolic extract inhibited embryonic development (40%, 45%, and 10%) and hatching of

embryonated eggs (40%, 85%, and 80%),respectively at 3.5 mg/ml. only ethanolic extract killed L1(97.18%) and L2 (92.68%) larvae of H. polygyrus after 24 hrs at 3.5 mg/ml and drastically reduced the production rate (6% at 3.0 and 3.5 mg/ml) of infective larvae (L3) after 5 days of incubation compared to other extracts ($p< 0.05$). However, the infective larvae of H. polygyrus were resistance to the effect of each of the tasted products (extracts and Mebendazole). These *Invitro* results suggested that the extracts of Canthium mannii, used by traditional healers in Dschang, Western region of Cameroon (Central Africa) to cure intestinal helminthiasis and abdominal pains of their patients, possess nematocidal properties. The active principles responsible for the activity could be secondary metabolites such as alkaloids and saponins present in the extracts. It is suggested that further experiments incorporating invivo purification of extracts and toxicological investigations should be carried out.

K. *In vitro* and Invivo anticancer activity

Purushoth Prabhu *et al.* (2011) reported ethanolic extract of *Canthium Parviflorum* Lam. on DLA and HeLa cell lines. The *In vitro* anticancer activity was measured by MTT assay and Exclusion method. The *invivo* study was determined in mice using Dalton's lymphoma ascetic (DLA) cells. The ethanolic extracts of *C. Parviflorum* greatly inhibited DLA and Hela cell growth with IC50 Of 61.24µg/ml and 43.15µg/ml respectively. A significant increase in the life span and a decrease in the cancer cell number & tumour weight were noted in the tumor induced mice after treatment with Canthium Parviflorum Lam. Anticancer activity of *Canthium Parviflorum* was may be due to flavonoid present in the plant. Further studies are also in process to evaluate the most potent fraction of the plant and to isolate the constituents of the fractions.

L. Acute and sub-acute toxicity

Wabo Pone J *et al.*, (2011) was reported the ethanolic extract of *Canthium mannii Hiern* stem bark on Mus mosculus. Acute and sub-acute toxicity of ethanolic extract (ETE) of C. mannii was assessed on white mice (Mus mosculus). After 48 hrs of extract administration, no death was registered. It was deduced that LD_{50} was indisputably higher than 16 gm/kg body weight. The sub-acute toxicity was based on daily administration of 3 doses of ETE (300, 600, and 1200 mg/kg body weight) for 4 weeks; 1% DMSO served as negative control. As for the first experiment, no sign of toxicity was registered. Conversely, the sub acute doses stimulated and increased the weight rate of mice after 7 days of treatment. Except for the spleen weight, the doses administered did not modify the weight index. It was observed that, subacute doses induced and increased (a) the food (particularly) and water consumption according to time and (b) the number of red and white blood cells. It was thought that, ETE can stimulate the haematopoietic function. Finally, no time variation of the activity of alanine aminotransferase and aspertate aminotransferase enzyme was observed in the serum of euthanized mice. The results showed the innocuity of ETE of C. mannii and thus validated his utilization in Cameroonian traditional pharmacopoeia.

M. *In vivo* Antioxidant Activity

Purushoth Prabhu *et., al* 2012 reported that**,** Screening of *In vivo* antioxidant activity of ethanolic extracts of *Canthium parviflorum* Lamarck leaves were carried out and the results of Phytochemical tests showed that the presence of alkaloids, tannins, saponins, flavonoids, glycosides, phenolic compounds, terpenoids and steroids. The result indicated that *C. coromandelicum*

exhibit a significant antidiabetic and antioxidant activity in animal model and could be a potential source of natural antioxidant with great importance as therapeutic agent in preventing or slowing the progress of aging and age associated oxidative stress related degenerative diseases.

N. Antimicrobial and anti – HIV activity

Chinnaiyan SK, *et al*., (2013) reported *Invitro* antimicrobial and anti-HIV activity of *Canthium coromandelicum* leaf extract against bacteria, fungi, and viral component. The plant extract screened for their antimicrobial activity against 10 bacterial strain including Gram negative, Gram positive bacteria, and 6 fungal strains using agar well diffusion, and micro broth dilution assays. The *In vitro* anti-HIV assay was performed by reverse transcriptase (RT) and gp120 binding inhibition assay. The methanolic extract showed the broad spectrum antimicrobial activity. The minimum inhibitory concentration of 64, 124 µg/ml showed against *salmonella typhi* and *Candida albicans* respectively. The methanolic extract exhibit highest inhibition on HIV reverse transcriptase 78.67 ±0.13 and glycoprotein 120 binding 72.52 ± 0.13. The overall results provided information for the possible use of C. coromandelicum leaf extract in the control of microbial infection.

CONCLUSION

The reported pharmacological studies on Canthium coromandelicum confirm the traditional uses. The plant was found to be as antioxidant, antimicrobial, anti diabetic, anti bacterial, anti malarial, hepatoprotective agent. Most of therapeutic effects may be explained due to the presence of various phyto constituents like glycosides, tannins, Sugar, flacourtin, β-sitosterol, β-sitosterol- β-D-glucopyranoside, ramontoside, butyrolactone lignan disaccharide, flavonoids, coumarin such as scoparone and aesculetin etc. For standardization purpose the content of main marker constituent need to be defined so that it's therapeutic utility is ascertained. There needs to further investigate the studies on clinical trial, *in-vitro* and *in-vivo* studies.

REFERENCES

1. Achenbach Hans, Waibel Reiner, Addae-Mensah Ivan. Shazhisin methyl ester gentiobioside, a new iridiod. Isolation and synthesis. Tetrahedron Letters (1981); 21(38): 3677-3678.
2. Akomo E F O; Zongo C; Karou S D, Obame L C, Savadogo A, Atteke C, Traore A S "*Invitro* antiplasmodial and antibacterial activities of *Canthium multiflorum* schum and Thonn (Rubiaceae) extracts." *Pakistan journal of biological sciences*; PJBS (2009), 12(12), 919-923.
3. Anitha. B., Mohan V.R., Athiperumalsami. T, and Sudha. S. Ethnomedicinal plants used by kanikkaras of Tirunilveli District, Tamilnadu, India to treat skin diseases. Ethnobotanical leaflets. 2008: 12, 171-180.
4. Ayyanar. M., Sankarasivaraman K., and Ignacimuthu. S. (2008). Traditional Herbal Medicines used in the treatment of Diabetes among two major tribal groups in south Tamil Nadu, India. *Ethnobotanical Leaflets*. 2008: 12, 276-280.
5. Bridson DM (1985). "The reinstatement of *Psydrax* (Rubiaceae, subfam. Cinchonoideae tribe Vanguerieae) and a revision of the African species". *Kew Bulletin* **40** (4): 687-725.
6. Bridson DM (1986). "The reinstatement of the African genus *Keetia* (Rubiaceae subfam. Cinchonoideae tribe Vanguerieae)". *Kew Bulletin* **41** (4): 965-994.
7. Bridson DM (1987). "Studies in African Rubiaceae - Vanguerieae: a new circumscription of *Pyrostria* and a new subgenus, *Canthium* subgen. Bullockia". *Kew Bulletin* **47** (3): 611-639.
8. Bridson DM (1987). "The recognition and recircumscription of the African genus *Multidentia* (Rubiaceae - Vanguerieae)". *Kew Bulletin* **47** (3): 641-654.

9. Bridson DM (1992). "The genus *Canthium* (Rubiaceae - Vanguerieae) in tropical Africa". *Kew Bulletin* **47** (3): 353-401.
10. Briggs LH, Cambie RC, Orgias EF. Constituents of *Canthium coprosmoides and Canthium glabriflorum*. *New Zealand Journal of Science* (1978); 21(3): 377-378.
11. *Canthium* In: Index Nominum Genericorum. In: Regnum Vegetable.
12. Chandra Kala S, Mallikarjuna K, and Aruna P. Qualitative phytochemical analysis of seed and leaf callus extracts of *Canthium parviflorum* Lam. Guntur district, Andhra Pradesh. *International Journal of Pharma and Bio Sciences* (2012); 3(4): 177-182.
13. Chatterjee TK, Basak A, Barua AK, Mukherjee K, Roy LN. Studies on the structure and stereochemistry of canthic acid – a new triterpene acid sapogenin from *Canthium dicoccum.* Transactions of the Bose Research Institute (Calcutta) (1979); 42(3-4): 85-88.
14. Chatterjee TK, Nagar A, Barua AK, Mukherjee K. Chemical investigation of the stem bark of *Canthium dicoccum*. *Journal of Indian Chemical Society* (1982); 59(3): 418-419.
15. Chen Gaungying, Wang Anwei, Song Xiaoping, Chen Gaungying, Wang Jihong, Ma Jingya. Chemical constituents of the stems of *Canthium simile*. *Huaxue Yanjiu Yu Yingyong* (2009); 21(7): 1024-1026.
16. Dan Mrs. S, Dan SS, Mukhopadhayay P. chemical examination of three indigenous plants. *Journal of Indian Chemical Society* (1982); 59(3): 419-420.
17. Das subhas C. 3-epi-Betulin, a new triterpenes from Canthium dicoccum. Structure, stereochemistry, and conversion from Betulic acid. Chemistry & Industry (London, United Kingdom) (1971), 52(11), 1112.
18. Dongo Etienn, Ayafor Johnson Foyere, Sondengam BeibamLucas, Connolly Joseph Donald. A new peptide alkaloid from *Canthium anorldianum*. *Journal of Natural Product* (1989); 52(4): 840-843.
19. Gunasegaran R, Subramani K, Azantha Parimala P, Ramchandran Nair AG, Rodriguez B, Madhusudanan K P. 7-o-(6-o-benzoyl-beta-D-glucopyranosyl)-rutin from leaves of *Canthium dicoccum*. *Fitoterapia* (2001); 72(3): 201-205.
20. Herath WHM, Sultanbawa MUS, Wannigama GP, Cave Andre. Chemical investigation of Ceylonese plants. Part 34. Alkaloidal and other constituents of *Uncaria elliptica and Canthium dicoccum*. *Phytochemistry* (1979); 18(8): 1385-1387.
21. Jose Beena, Jirovetz Leopold, Shafi PM. Phytochemical studies on the thorns and leaves of *Canthium parviflorum* Lam. *Asian Journal of Chemistry* (2008); 20(7): 5372-5376.
22. Kanchanapoom Triptch, Kasai Ryoji, Yamasaki Kazuo. Iridoid and phenolic diglycosides from *Canthium berberidifolium*. *Phytochemistry* (2002); 61(4): 461-464.
23. Lamarck J-B (1785). *Encyclopédie méthodique par ordre des matières*. **1**. pp. 602.
24. Lantz H, Bremer B (2004). "Phylogeny inferred from morphology and DNA data: characterizing well-supported groups in Vanguerieae (Rubiaceae)". *Botanical Journal of the Linnean Society* **146** (3): 257–283. doi:10.1111/j.1095-8339.2004.00338.x.
25. Lantz H, Bremer B (2005). "Phylogeny of the complex Vanguerieae (Rubiaceae) genera *Fadogia*, *Rytigynia*, and *Vangueria* with close relatives and a new circumscription of *Vangueria*". *Plant Systematics and Evolution* **253**: 159-183. doi:10.1007/s00606-005-0313-9.
26. Mahishi Parinitha, Srinivasa B.H., and Shivana. M.B. Medicinal plant wealth of local communities in some villages in Shimoga District of Karnatka, *Indian Journal Ethno pharmacology*. 2005: 98 (3), 307-312.
27. Mohideen. S., Ilavarasan. R., Hemalata S., Anitha, N., and Sasikala, E. Wound healing and diuretic activities of Canthium parviflorum Lam. *Natural product sciences.* 2003: 9 (2), 102-104.
28. Mukherjee Kaberi, Bose Latika. Chemical investigation of *Canthium dicoccum*. *Journal of Indian Chemical Society* (1975); 52(11): 11-12.
29. Naharstedt Adolf, Rockenbach Juergen, Wray Victor. Phenylpropanoid glycosides, a furanone glycoside and geniposidic acid from

members of Rubiaceae. *Phytochemistry* (1995); 39(2): 375-378.
30. P.sathya pariva, J.M. Sasikumar and G. Gowsigan Antibacterial activity of methanolic extract of *Ruta chalapensis* (L), *Quercus infectoria* (Oliver) and *Canthium parviflorum* (Lam*) Anc Sci Life*. 2009 Oct-Dec; 29(2): 28–31.
31. Pasumarthi Sasidhar, Chimata Murali Krishna, Chetty Chellu S, Challa Suresh. Seening of phytochemical compounds in selectedmedicinal plants of Deccan Plateau and their viability effects on Caco-2 cells. *Journal of Medicinal Plants research* (2o11); 5(32): 6955-6962.
32. Purushoth Prabhu.T, Panneerselvam.P, Selvakumari. S1 , Sivaraman.D. "Invitro and Invivo anticancer activity of Ethanolic extract of *Canthium Parviflorum Lam* on DLA and Hela cell lines", Int. J. Drug Dev. & Res., Oct-Dec 2011, 3(4):280-285.
33. purusoth prabhu T., selva kumari S., clement Atlee W., vijayakumar R., Suresh R., Antioxident Activity of Ethanolic Extract of *Canthium Parviflorum* Lamk in Alloxan induced Rats. *International Journal of Ayurvedic And Herbal Medicine* 2:5 (2012)766:670.
34. Quattrocchi U (2000). *CRC World Dictionary of Plant Names*. **1**. Boca Raton, New York, Washington DC, London: CRC Press. ISBN 978-0-8493-2675-2.
35. Rahal Widanagamage, Sagarika Ekanayake Oral hypoglycaemic effect of *Canthium coromandelicum* leaf extract on Wistar rats.*Vidyodaya J. of Sci.* (2009): 14, 53-57.
36. Raja Rajeswari N, RamLakshmi S, Muthuchelian K. GC-MS analysis of bioactive components from the ethanolic leaf extract of *Canthium dicoccum* (Gaertn.) Teijsm & Binn. *Journal of chemical and pharmaceutical research* (2011); 3(3): 792-798.
37. Razafimandimbison SG, Lantz H, Mouly A, Bremer B (2009). "Evolutionary trends, major lineages, and new generic limits in the dioecious group of the tribe Vanguerieae (Rubiaceae: insights into the evolution of functional dioecy". *Annals of the Missouri Botanical Garden* **96** (1): 161-181. doi:10.3417/2006191.
38. Sambandan K, Dhatchanamoorthy N. Studies on the Phytodiversity f a Sacred Grove and its Traditional Uses in Karaika.
39. Sanjeeb Kumar Patro, Padma Charan Behera, Posa Mohesh Kumar, D. Sasmal, Ranjan Kumar Padhy, S. K. Dash. Pharmacological Review of *Flacourtia sepiaria* (Ruxb.). *Sch. Acad. J. Pharm*., 2013; 2(2): 89-93.
40. Santhosh Kumar Chinnaiyan, Mohon Raj Subramanian, S. Vinoth Kumar, Atul N. Chandu, Karthkeyan Devaigamani. "Antimicrobial and anti-HIV activity of extracts of Canthium coromandelicum (Burm.f.) Alston leaves." *Journal of Pharmacy Research* (2013).
41. Satish kumar. T., Sahanmugam. S., Palvannan. T., and Bharati Kumar V. M., Evaluations of antioxidant properties of *Canthium parviflorum* Lam leaves. *Natural Product Radiances*. 2008 7(2). 122-126.
42. Schwarz Brunhilde, Wray Victor, Proksch Peter. A cyanogenic glycoside from *Canthium schimperianum. Phytochemistry* (1996); 42(3): 633-636.
43. Subramani, K, Gunasegaran, R,; Shiyamala, C,; Ganesan , T. Antifungal activity of certain Flavonol glycosides and phenolic acid from *Canthium* species. Advances in plant sciences (2004) 17(2), 745-748.
44. Suresh K, Kotaimuthu R, Norman TSJ, Kumuthakalavalli R, Simon SM. Ethnomedicinal study of medicinal plants used by malayali tribals in kolli hills of Tamil Nadu, India. *International Journal of Research in Ayurveda & Pharmacy* 2011; 2(2): 502-508.
45. Traore-Coulibaly Maminata, Jaroszewski Jerzy W, Olsen Carl Erik, Ouedraogo Jean Bosco, Pierre Guisso I, Nacolma Odile G, Guiguemde T Robert, Christensen S Broegger. A new oxygenated ursane derivative from *Canthium multiflorum.* Planta Medica (2008); 74(5): 560-562.
46. Traore-Coulibaly Maminata, Ziegler Hanne L, Olsen Carl Erik, Hassanata Millogo-kone, Pierre Guisso I.19alpha-hydroxy-3-oxo-ursa-1, 12-dien-28-oic acid, an antiplasmodial triterpenoid isolated from *Canthium multiflorum. Natural Product Research* (2009); 23(12): 1108-1111.

47. W V R T D G Bandara, Sagarika Ekanayake, E R Jansz and K Balasubramanium. The hypocholesterolaemic effect of *Canthium Coromandelicum* leaf on Wistar rats. *Vidyodaya J. of Sci.* 14. (2009), 105-109.
48. Wabo Pone, J.; Bilong Bilong, C. F.; Mpoame, M. Acute and sub-acute toxicity of ethanolic extract (ETE) of C. mannii Hiern stem bark on Mus mosculus. *Indian journal of experimental biology* (2011), 49(2), 146-150
49. Wabo Pone, J.; Bilong Bilong, C. F.; Mpoame, M. Invitro nematocidal activity of extracts of *Canthium mannii* (Rubiaceae) on different life-cycle stages of Heligmosomoides polygyrus. *Journal of Helminthology* (2010), 84(2), 156-165.
50. Wabo Pone, J.;Mbida, Bilong Bilong, C. F.; Mpoame, M. Invivo evaluation of potential nematocidal properties of Ethanolic extracts of *Canthium mannii* (Rubiaceae) on different life-cycle stages of Heligmosomoides polygyrus of rodents. (2009), 166(1-2), 103-107.
51. Wang Anwei, Chen Gaungying, Yin Wenqing, Han Changri, Zhang Yongqiang. Chemical constituents from the stems of *Canthium simile* Merr. & Chur. Linchan Huaxue Yu Gongye (2008); 28(2): 124-126.
52. Warrier. P. k., Nambair. V.P.K., Ramankutty. C. and Vasudevan Nair. R. *Indian medical plants*. Oriental Blackswan publisher, Newdelhi. 1996: pp-366.
53. Yang Biao, Chen Guangying, Song Xiaoping, Chen Zhong, Song Xinming, Wang Jing. "Chemical constituents and antimicrobial activities of *Canthium horridum*." *Natural product communications* (2010), 5(6), 913-4.
54. Yang Biao, Chen Guangying, Song Xiaoping, Chen zhong, Song Xinming, Wang Jing. Chemical constituents and antimicrobial activities of *Canthium horridum*. *Natural Product Communications* (2010); 5(6): 913-914.
55. Yang Biao, Chen Guangying, Song Xiaoping, Chen zhong, Song Xinming, Wang Anwei. Advances chemical constituents and pharmaceutical activities in *Canthium* lam. *Hainan Shifan Daxue Xuebao, Ziran Kexueban* (2009); 22(3): 299-303.
56. Musilla MF, Dossaji SF, Nguta JM, Lukhoba CW, Munyo JM. *Invivo* antimalarial activity, toxicity and phytochemical screening of selected antimalarial plants. *Journal of Ethnopharmacology* (2013); 10: 10-16.
57. Loganayaki Nataraj, Manian Sellamuthu. *Invitro* antioxidant properties of indigenous underutilized fruits. Food Sciences and Biotechnology (2010); 19(3) : 725-734.
58. Song Xinming, Chen Guangying, Yin Wenqing, Wang Anwei, Zhang Yonggiang, Xie Dongxia. Study on determination of total polyphenol content and antioxidant activity of leaves from *Canthium horridum* BI. Shipin Gongye Keji (2009); 30(6): 91-93.

Table 1. The plant parts having various ethnomedicinal uses

Sl. No.	Plant Part used.	Ethnomedicinal claims.	References
1.	Roots	• Traditionally used for snake bite when taken along with millk**.**	Mahishi P *et al*., (2005)
2.	Leaves	• Tender leaves are boiled and tied on the infected part to remove the thorns that have got into the skin. • Intestinal worms in children given at regular intervals. • Decoction of leaves is used for wound healing in animals. Significant antioxidant and diuretic activity was exhibited by extracts of leaves. • Scabies and the ring worm infection. • Dietary supplementary also as a salad.	Anita. B *et al*., (2008) Ayyanar. M *et al*., (2008) Maohideen S *et al.* (2003) *Natural Beauty Creations Medicinal plants directory*, Srilanka (2011)
3.	Roots and leaves	• Diuretic purposes. • In vitiated conditions of Kapha, diarrhea, strangury, fever, leucorrhoea, intestinal worms, and general debility. • Astringent, sweet, thermogenic, febrifuge.	Suresh K *et al.* (2011) Warrior. P. k *et al.* (1996)
4.	Barks	• Made into a paste with turmeric and lime and applied on the forehead to cure headache.	Sambandan K *et al.* (1996)
5.	Fruits	• Intestinal worms in children given at regular intervals. • Astringent, cholagogue, strengthening and an expellant of phlegm and bile.	Mahishi P *et al*., (2005)
6.	Whole plant	• Diabetes among major tribal groups in South Tamilnadu. • Indigestion, nausea, dysuria, impotence, decreased sperm count, and in renal calculi. • Diarrhea, fever, and constipation. • Control high blood pressure and reduce unwanted fats in the body**.** • Purifies the circulatory system, therefore acting as good for health.	Kirtikar K R , Basu B D, Indian Medicinal Plants, (2001) (www.wikipidia org) **S**atish Kumar *et al.*, (2008) *Natural Beauty Creations Medicinal plants directory*, Sri lanka (2011)

Table 2. Phytochemical investigation

Sl. No.	Species name	Plant part	Phytoconstituents	References
1.	*Canthium parviflorum*	Leaf	Alkaloids and Phenolic glycosides	Marimuthu *et al*.(2012)
2.	*Canthium parviflorum*	Seed & leaf callus	Terpinoids, saponins, steroids, tannins, quinines and gums in leaf callus & terpenoids, phenols, saponins, gums, oils and quinines in seeds.	Chandra Kala S *et al*, (2012)
3.	*Canthium parviflorum* & *Canthium gladiate*	Leaf	Tannins, alkaloids, flavonoids, saponins, steroids, anthraquinones and reducing sugars.	Pasumarthi sasidhar *et al*, (2011)
4.	*Canthium parviflorum*	Leaf	Alkaloids, oils, flavonoids, gums, phenols, saponins, steroids, tannins, and terpenoids.	Haroled peter *et al*, (2011).
5.	*Canthium dicoccum* (Ethanolic extract)	Leaf	(1). Spathulenol, (2). Caryophyllene oxide (3). Cedren-13-ol. (4). Ledene oxide. (5). m-mentho-4,8-diene. .(from GC-MS analysis) (6). 2-furancarboxaldehyde	Raja Rajeswari *et al*, (2011).
6.	*Canthium horridum*	Stem	1. Syringaresinol. 5. Mannitol 2. Scoparone. 6. Beta-daucosterol 3. Scopoletin. 7. Beta-sitosterol 4. Syringic acid. 8. Sinapic aldehyde. 9. 3'-methoxy-4'-hydroxy-trans-cinnamaldehyde 10. Vanillic acid-4-O-beta-D-glucopyranoside.	Yang Biao *et al*, (2010)
7.	*Canthium simile*	Stem	**(1).** Isovanillic acid (2). Caruilignan D, (3). 3β-28- Norlup-20, 29-ene-3, 17-diol. (4). 3, 4-dimethoxy-2,4-hexadienedioic acid. (5). Syringic acid (6). Di-Butyl phthalate, (7). Di-isobutyl phthalate.	Chen Guangying *et al*, (2009).
8.	4species of *Canthium* in china	-------	**Glycosides, triterpenes, coumarins and alkaloids.**	Yang Biao *et al*, (2009)
9.	*Canthium multiflorum*	Root	**An antiplasmodial triterpenoids**: 19alpha-hydroxy-3-oxo-ursa-1, 12-dien-28-oic acid. (a new ursenoic acid derivative)	Traore Maminata *et al*, (2009)
10.	*Canthium multiflorum*	Schum & thorn	**Alkaloids, terpens and tannins** from methanolic extracts (Invitro antiplasmodial and antibacterial activity)	Akomo EFO *et al*, (2009)
11.	*Canthium multiflorum*	Root	**A new ursane derivative**: 3-oxo-15alpha, 19alpha-dihydroxyursa-1, 12-dien-28-oic acid. Along with (i).10-O-acetylgeniposidic acid, (ii).6, 7-dimethoxycoumarin, (iii). 5,6,7-trimethoxycoumarin (iv). hymexelsin, (v). Scopoletin	Traore Maminata *et al*, (2008)

12.	*Canthium simile*	Stems	(1). Lupiol, (2). 3-β-acetyl Oleanolic acid, (3). β-sitosterol, (4). 2,4-dihydroxy-3,6-dimethyl benzoate, (5). 2,6-dimethoxy-p-benzoquinine, (6).β-daucosterol, (7). Vanillic acid.	Wang An-wei *et al*, (2008)
13.	*Canthium parviflorum*	Leaf	**Cardiac glycosides, coumarins, anthraquinones, saponins and reducing sugars etc.**	Satish Kumar et al., (2008)
14.	*Canthium parviflorum*	Thorns & Leaves	**Taraxerrol, D-mannitol, petunidin, & B-sitosterol, sakuranetin-4'-O-glycoside**	Jose Beena *et al*,(2008)
15.	*Canthium berberidifolium*	Aerial	**1). An iridoid diglycoside**: 6-o-beta-D-apifuranosyl-mussaenosidic acid. **2). Four phenolic glycosides**: canthosides A-D	Kanchanapoom Triptch *et al,* (2002)
16.	*Canthium dicoccum*	Leaves	7-o-(6-o-benzoyl-beta-D-glucopyranosyl)-rutin	Gunasegaran R *et al*, (2001)
17.	*Canthium schimperianum*	seeds	**A cyanogenic glycoside**: 2R-[(2-methoxybenzoylgenoposidyl)-5-o-beta-D-apiofuranosyl-(1-6)-beta-glucopyranosyloxy]-2-phenyl acetronitrile.	Schwarz B *et al*, (1996)
18.	*Canthium gilfillanii*	Leaves	**A geniposidic acid**	Naharstedt Adolf *et al* (1995)
19.	*Canthium anorldianum*	Stem bark	**A new peptide alkaloid**: **Anorldianine** (isolated from chloroform extract)	Dongo Etienn *et al*, (1989)
20.	*Canthium didymum*	------	Esculetin, scopoletin, lupeol and β-sitosteryl acetate	Dan Mrs. S *et al*, (1982)
21.	*Canthium dicoccum*	Stem bark	2 coumarins (esculetin di-methyl ether and Scopoletin) & triterpene acid sapogenin (acetylursolic acid)	Chatterjee TK *et al*, (1982)
22.	*Canthium subcordatum*	Stem bark	Shazhisin methyl ester gentiobioside, (a new iridiod compound)	Achenbach *et al*, (1981)
23.	*Canthium dicoccum*	--------	Canthic acid- **a new triterpene acid sapogenin** (3β, 7β-dihydroxyolean-12en-28-oic acid)	Chatterjee TK *et al*, (1979)
24.	*Canthium dicoccum*	-------	Sitosterol, quinovaic acid, acetylquinovaic acid and Scopoletin	Herath WHM *et al*, (1979)
25.	*Canthium coprosmoides*	Wood & Bark	2,6-dimethoxybenzoquinone, β-sitosterol, mannitol and ceryl alcohol. Mannitol, p-coumaric acid, octan01-ol.	Briggs LH *et al*, (1978)
26.	*Canthium glabrifolium*	Leaf	B-sitosterol, Mannitol	Briggs LH *et al*, (1978)
27.	*Canthium dicoccum*	Bark	**Terpinoids** : Oleanolic acid	Mukherjee *et al*, (1975)
28.	*Canthium dicoccum*	------	**A new triterpenes**:3-epi-betulin from Betulic acid	Das Subhas C (1971)
29.	*Canthium euryoides*	--------	**An alkaloid : Canthiumine**	Boulvin G *et al*, (1969)
30.	*Canthium glabrifolium*	Bark	**A new glucoside**: Calmatambin	Pyman *et al*, (1907)

Table 3. Preclinical pharmacological evaluations

Sl. No.	Species name	Plant part & extract	Preclinical Pharmacological activity	References
1.	*Canthium coromadelicum*	Leaf (Methanolic)	Antimicrobial and anti – HIV activity	Chinnaiyan SK, *et al*., (2013)
2.	*Canthium glaucum*	Stem bark (Aqueous)	Invivo antimalarial activity, toxicity and phytochemical screening of selected antimalarial plants.	Musila MF *et al*,(2013)
3.	*Canthium parviflorum*	Leaves (Ethanolic)	Antioxidant activity in Alloxan induced diabetic rats.	Purushoth P *et al*.(2012)
4.	*Canthium parviflorum*	Leaf Ethanolic	Invivo antioxidant activity	Purushoth P *et al*.(2011)
5.	*Canthium manni*	Stem bark (Ethanolic)	Acute and sub-acute toxicity was assessed on Mus mosculus (white mice)	Wabo Pone J *et al.,* (2011)
6.	*Canthium parviflorum*	Leaves (Ethanolic)	*Invitro* and *invivo* anticancer activity on DLA and Hela cell lines	Purushoth Prabhu. *et al*.(2011)
7.	*Canthium manni*	Stem bark (Ethanolic)	*Invitro* nematocidal activities on different life-cycle stages of Heligmosomoides polygyrus.	Wabo Pone J *et al.,* (2010)
8.	*Canthium parviflorum*	Fruit extracts	*Invitro* antioxidant properties of indigenous underutilized fruits.	Loganayaki Nataraj *et al*, (2010)
9.	*Canthium horridum*	Stem	Chemical constituents and antimicrobial activities	Yong Biao *et al*., (2010)
10.	*Canthium manni*	Stem bark (Ethanolic)	*Invivo* evaluation of potential nematocidal properties on Heligmosomoides polygyrus parasite of rodents.	Wabo Pone J *et al.,* (2009)
11.	*Canthium parviflorum* (Lam)	Leaves (methanolic)	Antibacterial activity	Sathiya Priya *et al*,.(2009)
12.	*Canthium horridum*	Leaves	*Invitro* antioxidant activity	Song Xinming *et al*,(2009)
13.	*Canthium manni*	Stem bark (Ethanolic)	*Invitro* antiplasmodial and antibacterial activities	Wabo Pone J *et al.,* (2009)
14.	*Canthium parviflorum*	Aerial (methanolic)	Antibacterial activity	Sathiya Priya *et al*,.(2009)
15.	*Canthium manni*	Stem bark (Ethanolic)	*Invivo* evaluation of potential nematocidal properties on Heligmosomoides polygyrus parasites of rodents.	Wabo Pone *et al*., (2009)
16.	*Canthium coromadelicum*	Leaves Hydroalcoholic	hypocholesterolaemic activity	Bandara W V R T D G *et al* (2009)
17.	*Canthium coromadelicum*	Leaves Ethanolic	Oral hypoglycaemic activity	Rahal Widanagamage *et al.* (2009)
18.	*Canthium multiflorum*	Schum and thorn (aqueous, acetone & methanol)	*Invitro* antiplasmodial and antibacterial activities	Akomo EFO *et al,* (2009)

19.	*Canthium parviflorum* (Lam.)	leaves Ethanolic	Evaluations of antioxidant properties	Satish Kumar. *et al* , (2008)
20.	*Canthium* species	Areal Hydro alcohol	Antifungal activity of certain flavonol glycosides and phenolic acids.	K Subramanian *et al*.,(2004)
21.	*Canthium parviflorum* (Lam.)	Aerial part of Aqueous	Wound healing and diuretic activities	Maohideen S *et., al.* 2003