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Evaluation of Potential Phytochemicals and Phyto Pharmacological Activities of *Erythroxylum monogynum* Roxb.

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Red cedar or Bastard sandal [*Erythroxylum monogynum Roxb*.] belongs to family Erythroxylaceae and commonly found in deciduous forests of India and Srilanka. The present work mainly deals with evaluation of phytochemicals present in various parts and pharmacological activities. Now a days a number of alternative medicines are avaliable for those diseases which are not cured by proper medicine. In this regard ayurveda or phytochemicals obtained from plants are using to cure diseases since long back in India due to their less toxic and side effects when compared with other source of medicine. Plants are considered to be the biosynthetic labs for a number of valuble phytochemicals. The phytochemicals found in leaf, stem, root of *Erythroxylum monogynum* known to contain a number of medicinal properties. Pharmocologically *Erythroxylum monogynum* shows Aantihyper lipidemic, Antioxidant, Aantibacterial, Antidiabetic, Antiplasmodial, Antiobesity, Antitumor, Cytotoxic, Ameliorative, Hepatoprotective, Nephroprotective activities. This work mainly provides information regarding, phytochemicals of various parts of plant, medicinal uses, Traditional importance, pharmacological activities .

Key words :*Erythroxylum monogynum* Roxb, Phytochemicals, Medicinal uses, Traditional importance , Pharmocolgical activities

Erythroxylum monogynum Roxb [Author – Roxburgh and Willium [1978] is a shrub or small tree about 7 m to 9 m height . O.E.Schulz placed this species in Sethia Section[1].This was commonly found in India , Srilanka[2], Mayanmar. In India it mostly found in states like Kerala, Karnataka, Tamil Nadu, Andhra pradesh. In Andhra Pradesh it found in places like Talakona of Chittoor district, Nellore, Batrepalli and kanwashram of Anantapur district, Vishakapatnam and Godavari districts. *Erythroxylum monogynum* contains a lot of vernacular names in respective regional languages[3]

Various vernacular names of *Erythroxylum monogynum*

English : Bastard sandal, Red cedar

Telugu : Paribadrakamu, Gatiri, Adivigoranti , Pagadapu , Gaadara

Tamil : Ayakkantamaram, Cakkaratapam, Cemmanatti , Citari, Vattukkolli

Kannada: Chambalu, Jeevadaali, Jeevadaane, Gandhagaru

Malayalam : Devaru , Chem, Chemmana

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Irulu: Sembulichan

Taxonomic hierarchy

Kingdom : Plantae
Division : Angiosperms
Order : Malpighiales
Family : Erythroxylaceae
Genus : *Erythroxylum*
Species: *monogynum*

Botanical profile

The leaves are simple and are arranged alternatively distichous ,they are obovate in shape. The leaf blade length is about 2.5 to 6.5 x 1-3 cm[4,5]. They are glossy light green and are about to 3-4 cm in length 1.5 cm in width with a half cm long petiole. The tip of leaf is rounded in shape. The leaf shows prominent midrib with pinnate reticulate venation.

The flowers are bisexual and are white in colour, auxillary, solitary or 1-4 in auxillary facsisles. There are 5-6 sepals which are ovate, acute and glabrous, There are 5-6 petals with white colour and are oblang with inner side containing ligule, imbricate, 10-12 stamens are present ,they are monadelphous, the ovary is 3-4 celled, 3-4 styles are present and are unte to single style containing capitates stigma. The ovary is superior with 3-4 cells,1-2 ovules present in each cell.

The fruit is a drupe type .It is ellipsoid apiculate and glabrous .The fruit is blood red in colour with single seed. The fruit is edibile one which people eats generally. The fruit is green in colour when unripe and is bright scarlet at maturity .This fruit is about 1 cm in lenghth and 4 mm across and have single seed .At the stage of ripening the colour gradually turns to blood red colour

The bark of *Erythroxylum monogynum* isdark brown in colour. Rarely patches are seen. The roughness of bark is due to the ridges and wrinkles which are there longitudinally and transversly. It shows fibrous fracture .The wood of *Erythroxylum monogynum* is hard The .The wood contain pleasent odour .The annual growth rings can be seen on surface .The wood is bitter in taste.It contains well defined root system. The root system is tap root system .The roots are well distributed to get sufficient anchorage and water with root caps.

Phytochemicals identified in various parts of *Erythroxylum monogynum*

In order to identify the nature of phytochemicals which are present in plant the analysis of phytochemical was done in various fractions[6]. By the phytochemical evaluation the various compound classes present in different parts of plants are also helpul to know potential pharmacological compounds in biological assay determination[7].

Leaves contain Ecgonine,Cinnamoyl cocaine[8,9]. Ecgonine is a tropane alkaloid [Formula: $C_9H_{15}NO_3$]. Cinnamoylcocaine is a natural tropane alkoloid [formula$C_{19}H_{23}NO_4$]

Erythroxylum monogynum leaf extracts of methanol and acetone showed that presence of saponins, tannins flavonoids, alkaloids, terpenoids, cardiac glycosides, carbohydrates and pytytosterol[10]. In hydroalcoholic leaf extract of Erythroxylum monogynum phytochemicals like Glycosides, Steroids, Flavonoids, Tannins, Phenols were present[11,39]

The rootbark contains several alkaloids like3 á-[3,4,5,-Trimethoxy cinnamoyloxy]6 â-benzoyloxytropane, 3 á-[3,4,5,-Trimethoxy benzoyloxy] tropane, 3 á-[3,4,5,-Trimethoxy cinnamoyloxy] tropane, á-[3,4,5,-Trimethoxy benzoyloxy] tropan-6 â, 7 â-diol[12]. Most of alkaloids were identified by GC-MS, the well documentation of tropane alkaloids fragmentation pattern was done[13]. The twenty alkaloids identified in the rootbark of Erythroxylum monogynum were Hygrine, Tropine, Tropinone, Pseudotropine

Butropine [3á-isobutyryloxytropane] , 3á-isobutyryloxy nortropane, Isoporoidne [3-[2-Methylbutyloxy]nortropane], Dihydrocuscohygrine, 3-[2-Methylbutyloxy] tropane, Cuscohygrine , Valeroidine [3á-Isovalery loxytropae-6 â-ol],Tropacocaine[3 â –Benzoyloxytropane] , 3-Phenylacetoxynor tropane, 3-[2-Methylbutyryloxy]tropane-6,7,diol, Convolamine [3 á-[3,4,-Dimethoxy benzoyloxy] tropane], 3 á-[3,4,5,-Trimethoxy benzoyloxy] tropan-6 â-ol , 3 á-[3,4,5,-Trimethoxy cinnamoyloxy] tropane, 3 á-Cinnamyloxytropane, 3á-Phenylacetoxy tropane, 3 á-Phenylacetoxytropan-6 â-ol, 3 á-[3,4,5,-Trimethoxy benzoyloxy] tropane, 3 â -Phenylacetoxy tropane, 3á-[4-Methylvaleroyloxy] tropane ,6 â-Benzyloxytropan-3á-ol, 3 á-[3,4,5,-Trimethoxy cinnamoyloxy]- 6 â-benzoyloxytropane, 3 á-[3,4,5,-Trimethoxybenzoyloxy]tropan -6 â,-7â-diol[14].

Hygrine[$C_8H_{15}NO$] is a pyrrolidine

alkaloid[15]. Hygrine, is a pyrrolidine alkaloid, and is the biosynthetic precursor of pharmacologically important tropane alkaloids[16]. Cuscohygrine is a pyrroldine alkaloid and was extracted from solanaceae family .Its chemical formula is $C_{13}H_{24}N_2O$.

These hygrine and cuscohygrine are present in leaves of coca[17,18].

Both hygrine and cuscohygrine are suitable markers for coca chewing as well as to discriminate the manufactured caca use with other in hair analysis criteria[19]

Tropine[$C_8H_{15}NO$] is a tropane derivative with hydroxyl group containing at third carbon. 3-Troponol is another name of this compound[21]. Tropinone $C_8H_{13}NO$ was sysnthesised by Robinson. R as a atropine precursor during first world war[22,23]. Pseudotropines [$C_8H_{15}NO$] are constituents in leaves of coca along with other alkaloids[24]. Ecgonine is an impartanat identifying parameter for usage of cocaine[25].

The wood contains Hibaeneepoxide, Monogynol, Devodarool, Alkoloids, Diterpenes such as erythoxydiol, erthroxytriol, Hydrocarbons, primaradiene, Isoatisirene, Atisirene, Devadorene erythroxytriols Q and P[20]

Medicinal properties and Ethnobotanical properties

The intake of bark ,wood used for stomach, stimulant, diaphoretic diuretic, and also effective for dyspepsia and as well as continued fever[26,27,37] yogurt was mixed with leaf extracts to kill worms of intestine and for to cure jaundice the leaf juice was used[4,28] .

The stem and root of plant is considered to contain huge number of properties and best medicinal parts[29].The medicinal properties of phytochemicals are claimed to treat skin diseases, diuretic, diaphoretic, stomach problems[30,31]. Leaf juice orally taken works as as a cooling beverage and for jaundice. The decoction of stem bark is used in treatment of hiccups[32]. *Erythroxylum monogynum* proved scientifically of containg antibacterial property[27], Hepato protective property[33] and as well as antidiabetic property[34].

The Erythroxylummonogynum leaves and Aloe vere roots are used as food during famine[35]. In India the Wood of Erythroxylum monogynum is used as an adulterant[36]. The Erythroxylum monogynum leaf and wood shows medicinal applications regarding rheumatoid arthritis and polio, rheumatoid arthritis, biliousness, polio, urticaria, rashes[38]. Flavonoids were observed in the leaves of *Erythroxylum monogynum*[40] Flavonoids contains antioxidant , antiplatelet, antiallergic, antithrombic, anti inflammation properties[41,42]

The stem bark paste of Erythroxylum monogynum along with coconut oil is used to treat skin diseases, scabies[47]

There is large demand for timber and is considered as a useful plant in dry evergreen forests[43]. The leaves, bark and fruits are very much useful medically[44]. The wood of boats are preserved from the tar obtained from wood of erythroxylum monogynum by distillation[45] and this is an oil[46]. The Oil obtained from plant contains sandalwood aroma and is used as perfume[45]. The stem bark phytochemical contains properties against diarrhoea[48]. The oil, fruit, bark of Erythroxylum monogynum are useful for bone fracture, diarrhoea, skin diseases and as well as fire wood[49]

Pharmocological activities

Erythroxylum monogynum was well known for its pharmoclogical activities. One of the great advantages of medicinal plants is that these are readily available and have no side effects[17]. World Health Organization (WHO)[18] has suggested the evaluation of the potential of plants as effective therapeutic agents, especially in area which we lack safe modern drugs.

The great factors in medicinal plants is they are avalaible readily and shows very less or no side effects[50]. WHO strongly suggested that it is very essential to go for phytochemical therapeutic agents when even there is no avalaiblity of modern safe drugs[51]

The metabolic disorder diabetes mellitus results hyperglycemia and abnormal metabolism of lipid, protein and showing effects on retina, nervous system, kidney[52]. Hyperglycemia is a significant factor for enchancement of complications regarding diabetes mellitus[53]

Erythroxylum monogynum anti diabetic property was evaluated in female wistar rats in which diabeties induced by Streptozotocin[34] for 6 days the diabetic rats were stabilized. The chloroform fraction of plant was administered from 7th day at a dose of 350mg per kg, and 500mg per kg for about 21days. The standard used here is Glibenclamide 10gm per kg. The

chloroform extract effect and standard drug on different parameters like blood glucose, weight of body and profile of serum lipid were recorded. The various histo pathological changes in pancreas in each group of representative animals were studied. The administered *Erythroxylum monogynum* chloroform fraction dose of 250mg per kg, 500mg per kg not showed any significant change in glucose level of blood in normoglycemic rats. On other side the depiction of oral glucose tolerance test showed a significant reduction in glucose level of blood for 30 to 60min. The parameters like glucose level in blood serum lipid are found to be significantly controlled by the extract of plant in the Streptozotocin induced diabetic rats. The results showed by chloroform fraction of *Erythroxylum monogynum* 500mg per kg were comparable with glibenclamide 10mg per kg standard treatment.

Similarly ethanolic leaf extracts of *Erythroxylum monogynum and Chonemorpha fragrans also* showed the antideabetic properties on alloxan introduced diabetic rats[54]

The phytochemicals from the Angiosperms are considered as new effective antiinfective agents[55]

From the past two decades the antimicrobial properties were well documented from parts of plant like leaves, roots, seeds, stem.[56]

Erythroxylum monogynum was utilized in traditional biomedicine to cure problems caused by micro organisms.[10] The plants phyto constituents evaluated for their anti microbial properties. The phyto compound showed their effect on bacterial species like *Klebsiela pneumonia, Staphylococcus aureus, Escherchia coli, Pseudomonas putida*. The plants extract showed its highest impact of inhibition on E.coli. The aqueous extract of *Erythroxylum monogynum* leaves showed highest inhibition zone against E.coli was 14.53mm followed by ethanol extract 13.70 mm

The leaf extracts of Erythroxylum monogynum was showed antimicrobial potential against microorganisms. The extracts showed presence of potential antibiotics with large spectrum of properties[57].

By using agar well diffusion method the antibacterial activity of extracts were determined[58,59]. Micro organisms were seeded on petriplates containing Mueller Hinton agar medium of 20ml. The wells which are with diameter of 6mm are separated from agar and extract solution which is 5mg/ml was later added . On observing diameter of growth inhibition zones the antibacterial activity was measured in mm for the strain on comaprision with the control[60]

Liver is one of the most important organ in the body and plays viatal role in metabolic reactions. The liver damage can be found by elevated levels of certain enzymes of serum like SGPT, SGOT, bilurubin[61]. Medicinally there are some plants which shows potential hepatoprotective activity[62].

To predict the hepatoprotective activity of *Erythroxylum monogynum* plant the rats which are induced with the [CCL4] 1ml/kg Crabon tetra chloride was selected and experiment was carried out for 7days[10]. By using the maceraton techniques the hydroalcholic extract was prepared. Five groups are rats were taken and were maintained as Control, CCL4 induced , CCL4 and Liver tonic, CCL4 and extract 150 milligram per kilogram and CCL4 and extract 200milligram per kilogram .The blood was collected on eighth day by retro orbital puncture for to study the parameters of serum like serum glutamate Oxaloacetate transaminase [SGOT], Serum glutamate pyruvate transaminase [SGPT] and the bilurubin. For to histopathological examinations the liver was isolated and processed. The SGOT, SGPT,totalbilurubin decreased levels were taken as an indication of hepatoprotective activity of extract in the treated rats. For the indication of hepatoprotective activity of extracts the regenerated hepatocytes are witnessed

Sabeena Hussain Syed et al., (2013) worked on thehepato protective activity of Erythroxylum monogynumm ethanolic extract of leaves on paracetamol introduced hepatotoxity in rats. The elevated serum levels like SGPT [serum glutamic pyruvic transaminase], SGOT [serum glutamic oxaloacetate transaminase],alkaline phosphatise and it was found that the total bilirubin was restored to normal[33]

Malaria is a disease which is caused due to the mosquito to humans and as well as other animals. In India due to its large population and great urbanisation it is very difficult to manage malaria[63] and the malarial parasite showing resistance to existing classes of drugs which are meant to malaria[64]

The antiplasmodial property was studied against *Plasmodium falciparum* by different

solvent leaf extracts of *Erythroxylum monogynum* methanol extract of plant 12.23µg per ml showed IC50 value. These results show that the leaf extracts are used in traditional practise and also source to evaluate more antiplasmoidal molecules from *Erythroxylum monogynum* leaf crude extracts.[65]

Obesity is a condition where excess amounts of body fats accumulated which directly or indirectly adverse the health.This is associated with increase in premature mortality, morbidity, improper, impaired quality of life[66,67,68]

The anti obesity property of *Erythroxylum monogynum* chloroform fraction was tested on wistar rats which are induced with high fat diet. For 56 days the female rats were fedded with a diet which is very rich in fats. The chloroform fraction of *Erythroxylum monogynum* was administrated 250mg per kg, 500mg per kg doses for last 21days continued with feeding fat diet. Body weight, feed consumption were monitored. After 57 days serum glucose, profiles of serum lipid, liver and total protein were estimated, Antherogenic index was calculated. Later the effect on significant organs likeheart, liver, kidneys and epididymal fat pad were observed and recorded.As a reson to treatment prominent reductionin weight of body and parameters like lipid, serumglucose, liver profle levels in animals which are fed on food of high fat improved significantly due to chloroform fraction treatment of plant The two main parameters like antheroginic index and weight of relative epidermal fat pad reduced with treatment of extract of plant[69].

Kidneys are the vital organs that aims to keep blood purify ,clean and also maintains chemical balance[70]Several works have shown that plants which are materials rich in secondary compounds like flavonoids, polyphenolic compounds Saponins, arginine and glutamic acid possess the activities like hypoglycaemic, hepatoprotective and the nephro protective activities in animals[71] The nephro protective property of *Erythroxylum monogynum* leaf ethanolic extract was observed in alloxan induced nephrotoxicity albino rats which are wistars strained. The significant reduction in the values of uric acid, urea and createnine was observed with the oral administration of extract. This indicates *Erythroxylum monogynum* ethanolic extract contains nephro protective property in case of alloxan induced nephro toxic rats[39].

The second largest common disease which is a major health burden is cancer[72,73] Plants are well used as medication for the cancer[74]. From natural resources about 60 percent of total anti cancer agents are derived[75] the natural resources like plants as well as marine organisms and microorganisms[76] In laboratory the plants which are susceptable and resistant to crown gall were analyzed for their antitumour activity, cytotoxic activity of which the constituents or compounds that antitumour or cytotoxic against human tumours. The highest cytotoxic activity showed by methanolic extract of *Erythroxylum monogynum* against brine shrimps of 172.3 ppm at an LC50. Further, the plant extract was tested against antitumour activity

Fig. 1. *Erythroxylum monogynum*

Fig. 2. Twigs of *Erythroxylum monogynum*

which was induced by Agrobacterium tumefaciens using antitumour bioassay of carrot disc. The studies showed that the activity of *Erythroxylum monogynum* inhibition of tumour even at very low concentration of 800 microgram per milli litre. All the results showed the strong anti tumour and cytotoxic activity in the crown gall susceptible plant[77]

Antioxidants inhibits the process called oxidation . Natural antioxidants present in the all plant parts. These antioxidants include carotenoids, phenols dietary glutathione, flavonoids vitamins endogenous metabolites[78]. Plant-based antioxidants function as singlet and triplet oxygen quenchers, free radical scavengers, , enzyme inhibitors, peroxide decomposers , synergists[79].

Erythroxylum monogynum aqueous and ethanolic extract of leaves are evaluated for anti oxidant activity invitro. Among these extracts the ethanolic extracts found to be potent to show more anti oxidant activity. By using various solvent systems the ethanolic extracts was further fractionated. The solvent systems are Chloroform, Pet ether, Ethyl acetate, n Butanol are used to evaluate antioxidant potential. The assay like DPPH and H, O, scavenging assay are used for to evaluate anti oxidant potential. For all these assays the reference compound used is Ascorbic acid. By using UV – Visible spectrophotometer all the analysis are carried out. Finally all the result showed the fractions and extracts of *Erythroxylum monogynum* leaves contains significant reducing power properties and free radical scavenging. Among all the chloroform fraction which was separated from ethanolic extract crude was found to contain significant anti oxidant potential[80].

By using the chromium precipitated testicular poisonous male albino rats an evaluation was carried out. The extract which was prepared by maceration approach. The male fertile albino rats were divided in to four groups of following,

Group 1	Control
Group 2	Chromium 150ppm in distilled water
Group 3	*Erythroxylummonogynum* alcoholic extract 200mg per kg, and chromium.
Group 4	*Erythroxylummonogynum* alcoholic extract 300mg per kg, and chromium.

For 30 days the extract and chromium was given orally. on 31st day through retro orbital plexus the rats blood samples were collected to perform serological tests. Then to separate the cauda epididymis and testies the sacrification of rats were done. In order to study the sperm count and motility the cauda epididymis was treated with saline. In group 2 the sperm count and motility is decreased. When compared with group 2 in case of group 3 and group 4 the sperm count and motility was increased. In extract treated groups the HDL, Albumin levels and total proteins were increased. In group 3 and group 4 rats triglycerides, total cholesterol, LDL (low density lipid) and VLDL(very low density lipid) reduction was observed. The rats which are dealed with extracts shown that the amelior active past time the reformation of semineferous tubule germinal cells of the testis[81].

Hyperlipidemia is a condition where abnormal levels of lipids are present in blood Hyperlipidemia which is a modifiable risk factor for atherosclerosis and related cardiovascular diseases, including coronary heart disease, cerebral stroke, myocardial infarction and renal failure are becoming a major health problem in the world recently[1]. The major health problems by hyperlipedemia are atherosclerosis, heart diseases, my cordial infarction, cerebral stroke, renal faliure are main problems recently in the world[82] Jacobson reported that this condition refers to lipid and cholesterol elevated levels in blood and is identified as dyslipidemia[83]. The *Erythroxylum monogynum* leaf extracts showed antihyperlipedemic property[84] The reduction in values of triglycerides and cholesterol on oral administration ethanolic extract of *Erythroxylum monogynum* plant was observed. This indicate the extract of leaves contain anti hyper lipidemic activity

CONCLUSION

The present review of *Erythroxylum monogynum* is a scientific evidence for pharmacological activities of phytochecimals present in various parts of plant. The phytochemicals present in leaf contains Anti microbial, Antiobesity,Antitumor and Anti cancerous, Ameliorative Nephroprotective,Anti plasmodial, Antioxidant, Antimalarial, , Antihyperlipidemic properties. This plant contains great number of phytochemicals with important disease curing properties. Still now work done on few phytochemical only .The plant not completely

explored. Therefore there is need to analyse the biological properties of these chemicals which helps in curing of other diseases.

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