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Review of cassia species and anti-microbial activity of *Cassia tora*

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Abstract
Herbal drugs having benefits over synthetic drug, which counteract the adverse effects of the synthetic drugs. But challenge remains the identification of the right herb and which part of the herb posses the pharmacological action to cure the disease. Cassia spices are widely available on roadsides and in many countries. The leaves and seeds of many cassia spices are a valuable remedy for skin diseases, especially for ringworm and itch. It is evident that *Cassia tora* seeds possess anti-bacterial and anti-fungal activity, hence leaves of *Cassia tora* were evaluated for the same anti-bacterial and anti-fungal activity. 50% and 100% methanolic extracts of *Cassia tora* leaves using cup-bore method were evaluated and a certain degree of anti-bacterial activity was observed. *Cassia tora* leaves do not have significant amount of compounds compared to their seeds that possess anti-bacterial and anti-fungal activity.

Keywords: *Cassia tora*, antimicrobial, methanolic extract, cup-bore method

Introduction
The word herb, as used in herbal medicine, also known as Botanical medicine or, in Europe, as Phytotherapy or Phytomedicine means a plant or plant part that is used to make medicine to assist the healing process during illness and disease. Herb can be a leaf, a stem, a root, a seed, a fruit, a flower, or bark, used for its medicinal properties. These may be used in many forms, e.g., fresh, dried, cut, as a powder, ointment, tincture, or oil extract, or made into liquid by infusion or decoction.

Herbs have provided all living organisms with medicine from the earliest beginning of civilization. Throughout history, various cultures have handed down their accumulated knowledge of the medicinal use of herbs. This vast body of information serves as the basis to some extent for today's allopathic medicine. About 25% of the modern drugs currently used by doctors have a component of an herb whose origin is often from the Amazonian rainforest or similar climate. But in today's allopathic medicine, most remedies are synthetic preparations devoid of any life-promoting vital energies. Nevertheless, allopathic medicine has its place and has saved many lives.

Today, there is a strong belief that allopathic medicines should be saved for when there is no other option for a particular disease or illness. If a safer, natural remedy is available, then it should be implemented before the use of a harsher, more powerful drug. A patient suffering from a life-threatening disease may require allopathic drugs combined with natural remedies providing the best of both therapies. The additional benefit of certain natural medicines is that they can counteract the side effects of allopathic drugs.

Following the strong interest of the public toward natural remedies, some doctors are now combining allopathy with naturopathy into their practice, which offers a much broader opportunity for curing and for the well-being of people.

It has been estimated that there are about 5,00,000 plant species on earth today, with the number varying depending on whether subspecies are included. Approximately 5,000 of these have been studied scientifically at length by modern science for their medicinal qualities. There are 121 prescription drugs in use today that come from only 90 plant species. Of these 121, 74% came from following up on native folklore claims. It is noteworthy that 80% of the world's population still relies on plant-based medicines.

There are many countries and cultures where people have inherited knowledge about plant medicine. South America, Africa, India, China, and Japan use herbs for healing many ailments

on a day-to-day basis, while in North American continent people have many beneficial medicinal plants as well.

Many of these plants were discovered and identified for their curative qualities by Native Americans, and therefore are referred to as "Indian Medicine". In the tropical rainforest, the medicinal plants are often referred to as "Jungle Medicine". These remedies are second nature to most of these native people, and even with the opportunity to receive modern medicine; they would prefer to heal their way because it works!!!

As an example, in Ghana and in other parts of Africa the belief is that in the dense tropical forest, there are medicinal properties in the undergrowth. But some harvesters believe that the plants that are more potent are the ones that receive direct insulation. So, many use grassland plants for certain diseases.

An experienced herbalist knows this information from extensive experience, research, and experiments.

There are different types of plant medicines in different ecosystems in Africa and in other continents. Those of the rainforest have different qualities than those which grow in the grassland or desert. Then there are those plants that overlap these areas, so it is important to know where each plant is from, to learn their benefits. An herbalist can determine which diseases an herb is to be used for by three main factors: where they are from, how much insulation they receive, and their chemical properties.

Many of these plant medicines have been proven, while others are new and in the experimental stages. These newer plants may, in addition to the timeless ones, share the potential to cure many of the illnesses we are presently faced with today.

Cassia Species

In India forty species of Cassia are reported. In Chhattisgarh 18 species occur naturally. These species are *C. absus, C. alata, C. auriculata, C. fistula, C. glauca, C. javanica, C. marginata, C. mimosoides, C. obtusifolia, C. occidentalis, C. pumila, C. renigera, C. roxburghii, C. siamea, C. sophera, C. surattensis, C. tora and C. tora* sensu. The species like Cassia sericea and Cassia senna are among the introduced species. Kasunda (Cassia occidentalis) and Kasuandi (Cassia sophera) are another Cassia species of great importance in Chhattisgarh. Both species are used as alternative to each other. The traditional healers of Chhattisgarh have rich traditional medicinal knowledge about these Herbs.

Major Cassia species and the botanical differences among them

Characteristics	Cassia auriculata	Cassia Fistula	Cassia Occidentalis	Cassia senna	Cassia tora
1) Habit	A profusely branched, tall, fast growing, evergreen shrub having height up to 6 meters	A deciduous, medium sized tree, up to 24 meters.	An erect, foetid, annual herb, or under shrub, 60-150 cm.	A variable, branching, erect shrub upto 1.8 meters.	A foetid, annual herb or undershrub, up to 1.2 meter.
2) Bark	Reddish brown, smooth	Grey smooth, exfoliating in small, woody scales, up to 1.5 cm thick.	----------	----------	----------
3) Leaf	7-10 cm long with large, auricled or rotundate reniform, foliaceous stipules, 7-9 pairs leaflets, oblong-obovate, obtuse or emarginate	20-40 cm, glandless; leaflets 4-8 pairs, distinctly stalked, 5-15 cm long, oblong, or ovate, clothed with silvery pubescent	10-20 cm long with cauducous stipules and a black gland near the base secreting nectar, peduncled racemes.	Pinnate, pubescent, leaflets pale green to bluish green, 3-9 pairs, lanceolate or elliptic, varying on the same plant	6.0-12.5 cm long, leaflets 3 pairs, membranous, ovate oblong with glands in the last two pairs, showing sleeping movements.
4) Flower	Yellow, 5 cm diameter, in terminal compund, corymbose- raceme; October-June	Bright yellow, in axillaty, pendulous, lax recemes, April-July	Yellow in short, peduncled racemes.	Brilliant yellow, in erect, terminal racemes.	Bright yellow, usually in pairs with very short, axillary peduncles.
5) Fruit	Pale brown, oblong, flat, papery, flexible, crumpled, 6-12 seeded pod, January-June from first year onward.	Cylindric, pendulous, smooth, hard dark brown or black 40-100 seeded, December-April	Recurved, glabrous, compressed pod	Fruit greenish when young to dark brown or black when mature, flat, thin, oblong, pubescent, 5-7 seeded	Stout pod, 15-25 cm long.
6) Seed	Compressed, tapering towards base	Light brown, hard, smooth, shiny, biconcave, embedded in sweetish pulp.	Dark, olive-green, ovoid, 20-30, smooth, shining	Dark brown, obovate oblong	Green, 25-30

- Colorimetric estimation of anthraquinone content, antimicrobial and laxative effects of leaves and pods of *Cassia fistula* Linn., *C. specatabilis* DC and *C podocarpa* Guill. And Perr. are described because of the popular uses of these species by herbalists in Ibadan. The pods of the Cassia species exhibited potent antifungal activity than the leaf samples. Pods of *C. fistula* showed significant antibacterial activity when compared to that of ampicillin. This study justifies the use of the Cassia species in traditional medicine.
- The rich traditional medicinal knowledge about different Cassia species clearly indicates that there is a tremendous scope for research on these species and for herb processors and pharmaceutical companies, Chhattisgarh is gold mine both in terms of traditional knowledge and natural raw material.

Cassia tora

1. **Botanical description**

- **Biological source**
- Chakramarda is a fresh plant leaves OR seeds of the plant *Cassia tora* Linn.

Family

Caesalpiniaceae

Geographical source

- **Native to:** Burma, China, Taiwan.
- **Grown in:** India, East & West Indies, Central America, Australia, Cambodia, Indonesia, Malaysia, Philippines, Japan, Vietnam, and Tibet.

Habitat

It is very common on roadsides and waste land.
It tolerates low soil fertilities and moisture levels.
It grows tallest where conditions are better.
It is cultivated near sea level and naturalized on cleared land.
It is becoming a weed in villages and thickets up to an elevation of 900 meters.

Morphology

An annual fetid herb 30-90 cm. high.

Leaves

- 7.5 – 10 cm. long
- Rhachis grooved, pubescent, with a conical gland between each of the 2 lowest pairs of leaflets.
- Stipules 1.3 – 2 cm. long, linear-subulate, caduceus.
- Leaflets 3 pairs, opposite, 2.5 – 4.5 by 1.3 – 2.5 cm. (The lowest pair the smallest), obovate-oblong, glaucous, membranous, glabrous, or more or less pubescent, base somewhat oblique, usually rounded.
- Main nerves 8-10 pairs.
- Petioles 2.5 mm. long, pubescent.

Flowers

- They are usually in subsessile pairs in the axils of the leaves, the upper crowded.
- The common peduncle in fruit is not exceeding 4 mm. long.
- Pedicels in fruit rarely exceed 8 mm. long.
- Calyx glabrous, divided to the base, segments are 5 mm. long, acute, spreading.
- Petals 5, pale yellow, sub equal, 8 by 2.5 mm., oblong, obtuse, spreading, the upper petal (Standard) 2-lobed, the others entire.
- Stamens 10, the 3 uppers reduced to minute staminosides, the remaining 7 perfect, subeqal.

Pods

12.5 – 20 cm. by 4 – 5 mm., subtetragonous, much curved when young, obliquely septate, puberulous, not reticulate, the sutures very broad.

Seeds

- 25 – 30 in number.
- 3 mm. long and brown in colour.
- Rhombohedral, with the long axis in the direction of the pod [1].

Microscopy

- Seed shows seed coat consisting of longitudinally elongated cells, covered with thick, smooth cuticles, followed by palisade layer composed of closely packed, radially arranged, non-lignified, thickened columnar cells, and by a single layer of dumb-bell shaped, thick-walled, parenchymatous cells.
- A wide zone of thick-walled, parenchymatous cells forming inner layer of testa present, differentiated into outer 8 – 10 layers of tangentially elongated, parenchymatous cells and a single layer of broad cells which are squarish in shape.
- A few vascular bundles scattered in this zone.
- Embryo consists of radicle, plumule and two cotyledons.
- Epidermis of cotyledons consists of a single layer, externally covered with cuticle, followed by two layers of palisade-like cells of mesophyll.
- Mesophyll of ventral side composed of rectangular to polygonal cells filled with round to oval starch grain, measuring 8 – 12 μ in diameter, a few vascular bundles and a few rosette crystals of calcium oxalate up to 49 μ in diameter, scattered in this region [2].

Powder

- Light brown; shows fragments of testa, parenchymatous cells, very small, numerous, simple, round to oval, starch grains measuring 8 – 12 μ in diameter, and a few rosette crystals of calcium oxalate up to 49 μ in diameter [2].

Identity, purity and strength

- **Foreign matter:** Not more than 2%
- **Total Ash:** Not more than 5%
- **Acid – insoluble ash:** Not more than 0.2%
- **Alcohol – soluble ext.:** Not more than 7%
- **Water soluble ext.:** Not more than 14%

Thin layer chromatography

T.L.C. of the silica gel 'G' plate using n-butanol: Acetic acid: Water (4:1:5) shows in visible light three spots at Rf. 0.33, 0.47 and 0.57 (all light yellow).under UV (366) three fluorescent zones are visible at Rf. 0.33 (blue), 0.47 (light pink) and 0.57 (blue). On exposure to Iodine vapor seven spots appear at Rf. 0.27, 0.33, 0.47, 0.57, 0.62, 0.71, 0.82 (all yellow) [2].

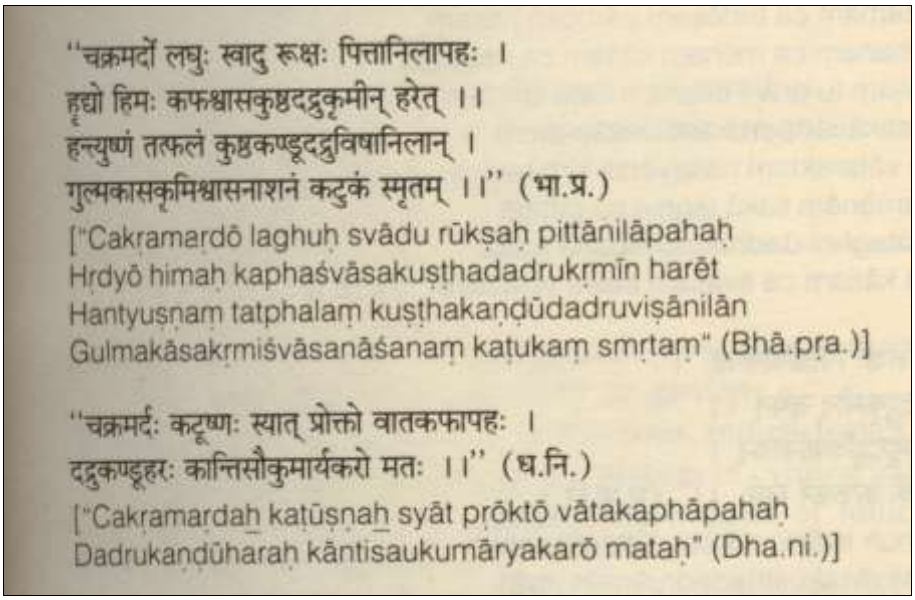
Vernacular Names

- **Hindi:** Chakvat, Chakunda, Pamad, Panevar
- **Gujarati:** Kawario, Kuvadio, Kovariya
- **Bengali:** Chakunda, Panevar
- **Oriya:** Cakunda
- **Marathi:** Tala, Tankli, Tarota
- **Tamil:** Tagarai, Senavu, Sirutagarai, Vindu
- **Telugu:** Tagirise, Tantemu, Tantiyamu
- **Malyalam:** Chakramandrakam, Takara
- **Sanskrit:** Cakramarda, Dadmari, Dadrughra
- **English:** Foetid cassia

Ayurvedic claims

- The leaves are used as a laxative in the form of decoction.
- Both leaves and seeds constitute a valuable remedy for skin diseases, chiefly for ringworm and itch.
- In China, the seeds are used externally and internally for all sorts of eye diseases; preparations are also given for liver complaints and boils.
- In Indo China, the pods are used in dysentery.
- In Nigeria, the leaves are used as a mild laxative.
- The weed is used in various Gold Coast medicines, chiefly as a purgative.
- In Madagascar and La Reunion, the root is considered bitter, tonic, stomachic.
- The leaves are used as an anti-periodic, aperient, anthelmintic; They are given to children with intestinal troubles [1].
- Chakramardah overcomes diseases due to impurity of blood, gives good complexion to the skin & removes

obstruction of urine and faecus.
- It rehabilitates the vitiated vata, pitta and kapha, but is especially effective for deranged vata and kapha.


"चक्रमर्दो लघुः स्वादु रूक्षः पित्तानिलापहः ।
हृद्यो हिमः कफश्वासकुष्ठदद्रुकृमीन् हरेत् ।।
हन्त्युष्णं तत्फलं कुष्ठकण्डूदद्रुविषानिलान् ।
गुल्मकासकृमिश्वासनाशनं कटुकं स्मृतम् ।।" (भा.प्र.)
["Cakramardō laghuḥ svādu rūkṣaḥ pittānilāpahaḥ
Hṛdyō himaḥ kaphaśvāsakuṣṭhadadrukṛmīn harēt
Hantyuṣṇam tatphalaṃ kuṣṭhakaṇḍūdadruviṣānilān
Gulmakāsakṛmiśvāsanāśanaṃ kaṭukaṃ smṛtaṃ" (Bhā.pra.)]

"चक्रमर्दः कटूष्णः स्यात् प्रोक्तो वातकफापहः ।
दद्रुकण्डूहरः कान्तिसौकुमार्यकरो मतः ।।" (ध.नि.)
["Cakramardaḥ kaṭūṣṇaḥ syāt prōktō vātakaphāpahaḥ
Dadrukaṇḍūharaḥ kāntisaukumāryakarō mataḥ" (Dha.ni.)]

Commercial uses
- As a substitute for tea and coffee.
- Seeds yield Tannins and Dyes (Yellow, blue, red) and used in dying industries.
- It yields a gum (7.5%), which is a good agent for suspending and binding.
- Seeds are used in preparation of sweet dishes.
- It is also used as a natural pesticide.

Worldwide uses
- **Laxative:** Anthelmintic
- **Liver tonic:** Anti-pyretic
- **Ophthalmic:** Cardiotonics
- **Expectorant:** In leprosy
- **In ringworm:** In flatulence
- **In colic:** In dyspepsia
- **In constipation:** In cough
- **In bronchitis:** In Cardiac disorder
- **Anti-arthritis:** Anti-pyretic
- **Antibiotic:** Anti-hypertensive
- **Germicide:** Anti-parasitical
- **In snake bite:** Oxytocic activities
- **In impotance:** In frigidity
- **In feelings of coldness:** In dizziness
- **Pain in the joints:** In sore throat

In deficiency syndrome of the kidney
In inflammation of the eye
Improves physical strength
Dilate capillaries to improve circulation
With lime juice it uses in skin itch and skin eruption.
With castor oil to foul ulcers and inflammations.
As a poultice, the warmed leaves of *Cassia tora* reduce gout, sciatica, and joint pains. Lowering cholesterol and reducing blood pressure.

Pharmacology
- The naphtha – pyrone glycosides were isolated which possesses the anti – hepatotoxic property. The 9–[(β-D-glucopyranosyl-(1←6)-O-β-D-glucopyranosyl) oxy]–10-hydroxy-7-methoxy-3-methyl-1H-naphtho[2,3-C] pyran-1-one {I} and 6-[(α-apiofuranosyl-(1←6)-O-β-D-glucopyranosyl)oxy]-rubrofusarin {II} together with Cassiaside {III} and rubrofusarin-6-β-gentiobioside {IV} were isolated from the seeds of *Cassia tora*. The naphtha-gamma-pyrone glycosides (II, III, and IV) were found to have significant hepato-potensive effects against galactosamine damage, which were higher than that of silybin from silybum marianum [5].
- These herbs contain many antigenotoxic compounds, including the Chrysophanol, Emodin & Rhein. The biological effects of unroasted *Cassia tora* were found to be higher than the roaste products. However, very little is known about the antigenotoxicity of Water Extract of *Cassia tora*. Water Extract from *Cassia tora* showed a marked antigenotoxic potential against dietary mutagens Glu-P-1 and Trp-P-1 in the Ames test and The Comet assay in order of unroasted, roasted at 150° and roasted at 250°. Water Extract of *Cassia tora* might produce molecular complexes with mutagens and exhibit scavenging effect on the reactive intermediates of Trp-P-1 generated from the metabolic system. The reduction in the anthraquinones content during roasting process was associated with the decreases in antigenotoxic effects.
  Chrysophanol, Emodin and Rhein were found to have protective effects on DNA damage induced by Trp-P-1 (79%, 64% and 38% respectively).
  Apart from the traditional pharmacological effects of *Cassia tora*, the water extracts of unroasted *Cassia tora* seed may have a potential health activity on the cancer chemoprevention.
- The purgative activity of the methanolic extract as well as that of isolated aloe-emodin from *Cassia tora* leaves was evaluated in Wistar rats [6].
- 59% of plant extract from 22 plant extract exerted activity on P. falciparum strain 3D7 (Chloroquine sensitive) with an IC 50 less than 50 µg/ml, whereas 43% of plant extract showed an IC 50 value within 50 µg/ml on Dd2 (Chloroquine resistant). Plant extract from Gardenia lutea, Haplophyllum tuberculatum, *Cassia tora*, Acacia nilotica and Aristolochia bracteolate possessed IC 50 values less than 5 µg/ml on both tested strains. Phytochemical analysis indicated that the most active phase contained terpenoids and tannins & was devoid of

alkaloid and saponins [7].

- The various chemical constituents possess the following activity which has been reported in Dr. Duke's Phytochemical and Ethnobotanical Databases [8].

Aloe – Emodin

- Anti-bacterial Dosage: MIC = 2 - 64 µg/ml
- Anti-herpetic
- Anti-leukemic
- Anti-salmonella
- Antiseptic Dosage: MIC = 2 - 64 µg/ml
- Anti-staphylococci Dosage: MIC = 2 - 64 µg/ml
- Anti-tumor Dosage: MIC = 1 µg/ml
- Anti-viral
- Arylamine-N-Acrtyltransferase-Inhibitor
- Calcium-Antagonist Dosage: (Strong activity)
- Candidicide Dosage: MIC = 25 - 250 µg/ml
- Cathartic
- Cytotoxic Dosage: 20 ppm
- Fungicide Dosage: MIC = 25 - 250 µg/ml
- Genotoxic
- Laxative
- Mutagenic
- Purgative Dosage: ED50=>59.6 mg/kg OR mus
- Termitifuge
- Topoisomerase-II-Inhibitor Dosage: 1 mM
- Tuberculostatic

Anthrone: Emetic

Aurantiobtusin: Anti- aggregant

Chryso-obtusin: Anti-aggregant

Chrysophanic acid – 9 – anthrone: Fungicide

Chrysophanol

1. Anti-bacterial
2. Antiseptic
3. Calcium – antagonist Dosage 5/6 aloe-emodin
4. Candidicide
5. Cathartic
6. Hemostat
7. Pigment

Emodin

1. Allergenic
2. Anti-aggregant
3. Anti-bacterial
4. Anti-cytomegalovirus Dosage: ED50 = 1.1 µg/ml
5. Anti-feedant
6. Anti-inflammatory Dosage: 15 mg/kg
7. Anti-leukemic
8. Anti-lymphomic
9. Anti-mutagenic
10. Anti-plaque Dosage: ED50 = 1.1 µg/ml
11. Anti-sarcomic
12. Antiseptic
13. Anti-spasmodic
14. Anti-sprout
15. Anti-tumor (Breast)
16. Anti-ulcer Dosage: 15 mg/kg
17. Anti-viral Dosage: ED50 = 1.1 µg/ml
18. CNS-depressant Dosage: 15 mg/kg ipr mus
19. Cathartic
20. Cytotoxic Dosage: ED50 = 2.6 µg/ml
21. Genotoxic
22. Gonadotropic
23. Hypolipidemic
24. Immunostimulant
25. Immunosuppressant
26. Leucocytogenic
27. Mutagenic
28. PTK – Inhibitor
29. Prostaglandin–synthesis–inhibitor Dosage:IC50 23 µM/ml
30. Purgative Dosage: ED50=> 500 mg/kg OR mus
31. Styptic
32. Topoisomerase-II-Inhibitor Dosage: 1 mM
33. Trichomonicide
34. Vasodilator

Fiber

1. Angiotensin receptor blocker
2. Anti-diabetic
3. Anti-hypertensive
4. Anti-obesity
5. Anti-tumor
6. Anti-ulcer
7. Beta blocker
8. Cancer – preventive
9. Cardioprotective
10. Diuretic
11. Hypocholeserolemic
12. Hypotensive Dosage: 10 gram/man/day/oral
13. Hypouricemic
14. Laxative
15. Vasodilator

Physcion

1. Antiseptic
2. Calcium Antagonist Dosage: 5/6 Aloe-emodin
3. Cathartic
4. Purgative Dosage: ED50=> 500 mg/kg orl mus
5. Angiotensin receptor blocker
6. Anti-arrhythmic
7. Anti-depressant
8. Anti-fatigue
9. Anti-hypertensive
10. Anti-spasmodic
11. Beta blocker
12. Cardiotoxic
13. Diuretic
14. Vasodilator

Rhein

1. Anti-bacterial
2. Anti-carcinomic
3. Anti-carcinogenic
4. Anti-cytomegalovirus Dosage: ED50 = 1.1 µg/ml
5. Anti-neoplastic
6. Anti-plaque Dosage: ED50 = 0.6 µg/ml
7. Anti-tumor
8. Anti-viral Dosage: ED50 = 0.61 µg/ml
9. Calcium Antagonist Dosage: 9/10 Aloe-emodin
10. Candidicide
11. Cathartic
12. Cytotoxic
13. Fungicide
14. Proteinase Inhibitor

15. Purgative Dosage: ED50 = 97.5 mg/kg orl mus

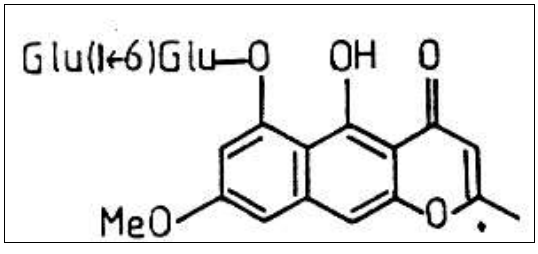
Toralactone

Antiseptic

- To discover the source with anti-oxidative activity in traditional medicines, 100 extracts of Korean medicinal plants were screened for their scavenging effect on peroxynitrite (ONOO-) and total reactive oxygen species (ROS). The potency of total ROS scavenging activity was shown in the extracts of 25 plants and 4 of their species: Macleaya cordada, Salvia plebeia, *Cassia tora* and Angelia gigas had a greater effect with IC 50 values of 1.7±0.36, 4.3±1.08, 4.9±0.17, and 5.8±1.01 μg/ml, respectively than that of trolox, positive control (7.61±0.12 μg/ml) [9].
- The spasmogenic effect of the methanol extract of the leaves of *Cassia tora* were evaluated on guinea pig ileum, rabbit jejunum and mice intestinal transit. Antinoceptive activity of the extract was also evaluated in the mice. The LD 50 values of the extract in mice were more than 2000 mg/kg i.p. and p.o. The extract contracted smooth muscle of guinea pig ileum and rabbit jejunum in concentration dependant manner. Atropine reversibly blocked this activity. Mepyramine also reduced the contractile amplitude due to the extract in a concentration dependant manner. The extract increased intestinal transit in mice dose dependently. *Cassia tora* extract significantly reduced the number of acetic acid induced abdominal constrictions in mice and the effect was comparable to that of aspirin (150 mg/kg i.p.). The extract also significantly reduced the nociceptive response of mice to increase force (g). The effects were dose dependant [10].

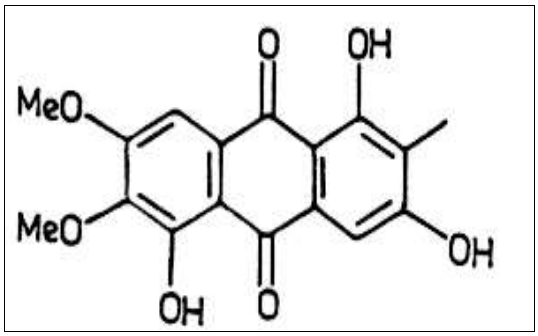
Chemical constitutes

- **Leaves:** Emodin, Kaempferol-2-diglucoside, d-mannitol, myricyl alcohol, β-sitosterol, glucose, trigonelline, 1-stachydnine choline.
- **Stem:** Ethyl arachidate, behenic acid, marginic acid, palmitic acid, euphol, aurapterol, β-sitosterol, basseol, emodin, rhein, 3, 5, 8, 3`, 4`, 5`- hexahydroxy flavone.
- **Roots:** Choline, 1, 3, 5-trihydroxy-6, 7-dimethoxy-2-methylanthraquinone, leucopelargonidin-3-O-α-L-rhamnopyranoside and β-sitosterol.
- **Seeds:** Rhein, Emodin, aloe-emodin, physcion, rubrofusarin, nor-rubrofusarin, 6-β-gentiobioside of rubrofusarin, 8-hydroxy-3-methylanthraquinone-1-β-gentiobioside, chrysophanic acid, chrysophanic acid 9-anthrone, obtusin, aurantio-obtusin, toralactone, torachrysone, sitosterol.
- A sterol, mp. 137°, myricyl alcohol, mp. 87°(Curr.Sci.1965, 34,481); isolation and structure of a new rubrofusarin glycoside (I) (Chem.Pharm.Bull 1969, 17,458) [11].

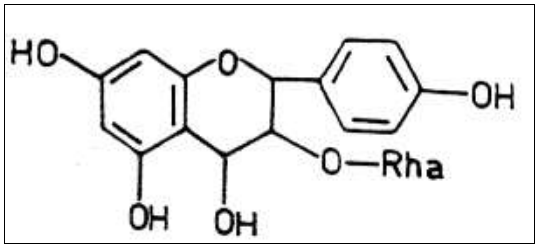


(I)

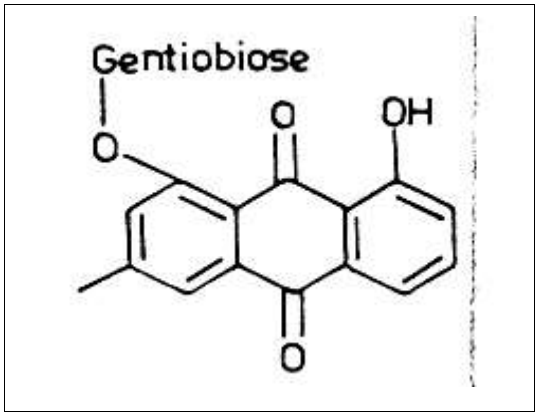
- Detection of palmitic (11.0), Stearic (9.5) and linoleic acids (49.1) in oil by reversed phase PC (Indian J. Appl. Chem. 1972,35; Chem. Abstr. 1973,79,96832 c); a new anthrax quinone pigment – 1,3, 5-trihydroxy-6,7-dimethoxy-2-methylanthraquinone, mp. 210°(II) – and leucopelargonidin-3-O-α-L-rhamnopyranoside, mp. 202°(III) along with β-sitosterol isolated from roots (Planta Med. 1972,21,393); a new naptho-α-pyrone – toralactone – isolated from seeds (Yakugaku Zasshi 1973,261; Chem. Abstr. 1973,78,156649 q); rubrofusarin-6-β-gentiobioside and a new anthraquinone glycoside – 8-hydroxy-3-methylanthraquinone-1-βgentiobioside (IV) – along with chrysophanol, physcion, emodin and rubrofusarin isolated from seeds (Indian J. Chem. 1974,12,1251); chrysophanic acid-9-anthrone, mp. 200°, isolated from seeds (Sci.Cult. 1974,12,1251); emodin isolated from leaves (Indian J. Pharm. 1977,39,116); triacontan-1-ol, stigmasterol, β-sitosterol-β-D-glucoside, friedelin, palmitic, stearic, succinic and d-tartaric acids, uridine, myo-inositol, d-ononitol, kaempferol, querscetin, juglanin, astragalin, quercitrin and isoquercitrin isolated from leaves (Yakugaku Zasshi 1978,98,1288; Chem. Abstr. 1978,89,193900 n); quantitative estimation of total anthraquinone (0.85-1.25%) in seeds (Shoyakugaku Zasshi 1979,33,72; Chem. Abstr. 1979,91,189795 f) [12].



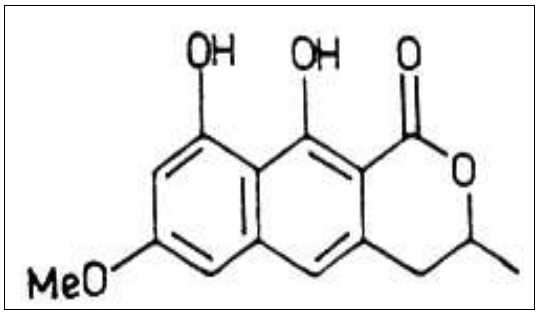
(II)



(III)

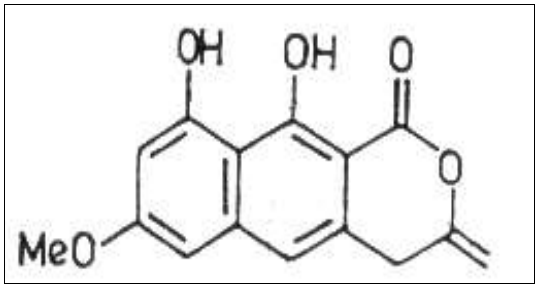


(IV)

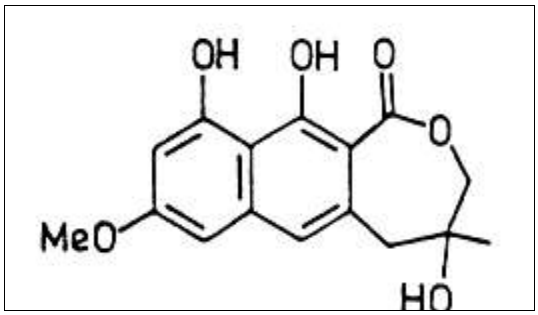


Toralactone

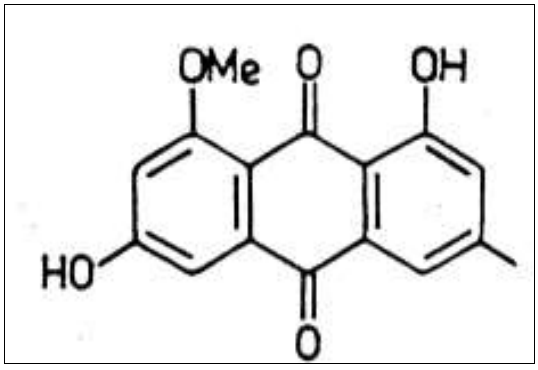
Torosachrysone and questin isolated from seeds and their structures determined (Nichon Daigaku Yakugaku Kenkyu Hokoku 1980,19,30; Chem. Abstr. 1981, 94, 20287 t) total ash (10.38) from seeds contained Ca (0.35), Na (0.19), K (1.0), and P (2.9%); oil (10.5%), glucose, gallactose, xylose and raffinose also isolated from seeds (J. Inst. Chemists, Calcutta 1981,53,230; Chem. Abstr. 1982,96,65718 s); two new lactones – isotoralactone and cassialactone – isolated from seeds along with torosachrysone and their structures elaborated (Phytochemistry 1981,20,1951); 3,5,8,3`,4`,5-hexahydroxyflavone, hydroxycoumarin, auraptenol, euphol, basseol, emodin, rhein, palmitic, isosteric and behenic acids, ethyl arachidate and β-sitosterol isolated from stem bark (Indian J. Chem. 1983, 22B, 1165) [13].



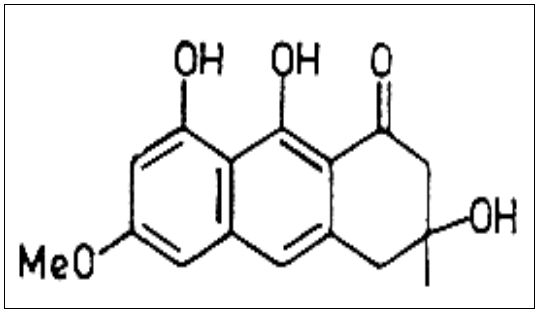
Isotoralactone



Cassialactone

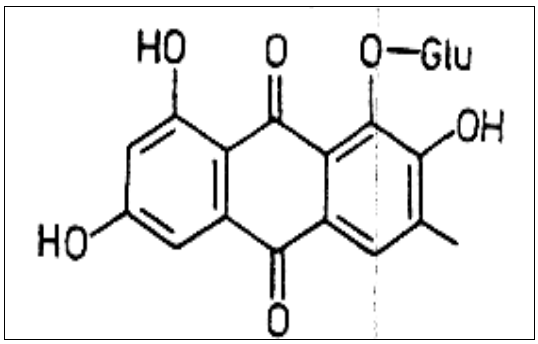


Questin

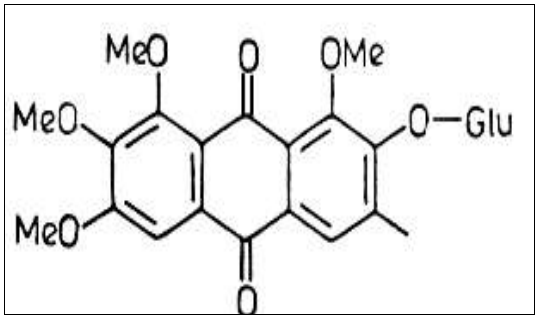


Torosachrysone

Emodin isolated from leaves (Indian J. Pharm. Sci. 1984,46,141); two new anthraquinones – a; aterinin-1-O-β-D-glucopyranoside and chrysoisobutin-2-O-β-D-glucopyranoside – isolated from seeds and characterised; physcion-8-O-β-D-glucoside a; so isolated (Chem. Pharm. Bull. 1985, 33, 1274), obtusin, obtusifolin, stigmasterol, histidine, chryso-obtusin, cystine, γ-hydroxyarginine and aspartic acid isolated (Proc. Indian Acad. Sci. Plant Sci. 1986, 96, 321); detection of gibberellins A3, A4, and A7 in anthers (Trans. Bose Res. Inst. Calcutta 1986,49, 29; Chem. Abstr. 1988, 109, 51694 f); helminthosporin, O-methyl-chrysophanol, betulinic acid and 2,5-dimethoxybenzoquinone isolated from roots and seed, aloe-emodin from roots only and questin, isotoralactone, and torosachrysone isolated from seeds only (Yakugaku Zasshi 1986, 106, 302; Chem. Abstr. 1986, 105, 85022 t); steam-volatile oil (0.014%) from seeds contained dihydroactinidiolide, m-cresol, 2-hydroxy-4-methoxyacetophenone, methyl palmitate and methyl oleate; free acidic and saponified matter of hexane extract of seeds contained palmitic, oleic and linoleic acids as major constitute, whereas, unsaponifiable matter consisted of C16-31 alkanes, Cholesterol, Stigmasterol, β-sitosterol and 1,3-dihydroxy-8-methylanthraquinone (Kinki Daigaku Rikogakubu Kenkyu Hokoku 1987, 103; Chem. Abstr. 1988, 109, 20269 s) [14].



Alaternin-1-O-β-D-glucoside



Chrysoobtusin-2- β-d-glucoside

Analysis

Leaves

1. Moisture – 82.5%
2. Proteins – 4.5%
3. Fats – 1.1%
4. Fiber – 2.2%
5. Carbohydrates – 8.0%
6. Minerals – 1.7%
7. Calcium – 520
8. Phosphorus – 39
9. Iron – 12.3.04
10. Thiamine – 0.19
11. Riboflavin – 0.83
12. Nicotinic acid – 0.83
13. Vitamin C – 82 mg/100 grams
14. Energy – 60 Cal/100 grams
15. Carotene – 16,920 IU [15]

Seeds

1. Moisture – 40.48%
2. Fats – 2.74%
3. Crude Fiber – 13.14
4. Carbohydrates – 48.53%
5. Ash – 7.34
6. Phosphorus – 0.362
7. Iron – 0.187
8. Crude Protein – 23.77
9. Lysine: 3.7
10. Histidine: 2.4
11. Threonine – 9.2
12. Phenylalanine – 4.8
13. Valine – 6.4
14. Methionine – 1.6
15. Tryptophan – 0.9
16. Leucine & Isoleucine – 15.1
17. Serine – 7.4
18. Glysine – 10.2
19. Tyrosine – 3.8
20. Cystine – 0.8
21. Arginine – 6.6
22. Glutamic acid – 10.6
23. Aspartic acid – 6.8
24. Alanine – 8.4
25. Proline – 0.6
26. Seed Oil: 5.0%

Physico-chemical constant of seed oil:

1. Specific Gravity: gr32° - 0.9012
2. nD32° - 1.4672
3. Saponification value – 163.4
4. Acetyl value – 11.2
5. Acid value – 4.2
6. Iodine value – 91.3
7. Thiocynogen value – 58.2
8. Unsaponified matter – 5.7
9. Fatty acid composition:
10. Palmitic acid – 23.5
11. Lignoceric acid – 3.4
12. Oleic acid – 28.1
13. Linoleic acid – 45.0 [15]

The aglycone content of rhein-like and non-rhein glycoside of *Cassia tora* is double than that of Cassia occidentalis, which is proved by C.S. Shah and M.V. Shinde. The anthraquinone aglycones are estimated after hydrolysis according to the methos of Schmidt and Anglikar by using Boroacetic anhydride (BEA) reagent on spectronic – 20. Rhein is estimated from the standard curve of rhein measuring the extinction at 486 μm and non-rhein like compounds are calculated from the standard curve of aloe-emodin measuring the extinction at 479 μm. Results are given below:

Rhein & non-rhein aglycones of glycosides

1. Cassia Cassia
2. Tora occidentalis
3. Rhein aglycone of glycoside%: 0.082 0.312
4. Non-Rhein aglycone of glycoside%: 0.047 0.163

The absorption maxima of anthracene derivatives lie very close to each other; therefore, it is necessary to seprate rhein like from non-rhein like portion [16].

S.K. Chauhan, B.P. Singh, and S. Agrawal *et al*. s reported a HPLC estimation of Chrysophanol in *Cassia tora*. The seeds constitute the drug of commerce which are used as in skin diseases such as ringworm and itch. Chrysophanol is an important constituent responsible for anti-fungal activity.

One gram of powdered sample was taken into 50 ml methanol (50%). The content was shaken with 5 ml of 5 N HCL and heated. Methanol was evaporated completely. Aqueous fraction was extracted with ether (10ml x 5). The ether extracts were pooled and passed through anhydrous sodium sulphate. The ether evaporated and residue thus obtained was dissolved in 10 ml methanol and used for further analysis.

A M/S waters HPLC system consisting of a theodyne 7125 injector, 996 photodiode array detector, 510 chromatographic pump and millennium software v.2.10 was used for estimation.

The test sample (1 gm/10 ml) was passed through 0.45 μ filter and 20 μl each of test solution and four different concentrations of standard chrysophanol (0.0375, 0.050, 0.075, and 0.150 μg/ml) were injected to HPLC using Nova Pak C-18 reversed phase column (3.9 X 150 mm). The mobile phase was Acetonitrile: Methanol: Water: Phosphoric acid – 50:25:25:1 and flow rate were 0.5 ml/min. The chromatogram was scanned up to 10 min., which was detected at 425 nm. The amount of chrysophanol in test sample was determined from the linear regression equation of the calibration graph plotted between concentration and area.

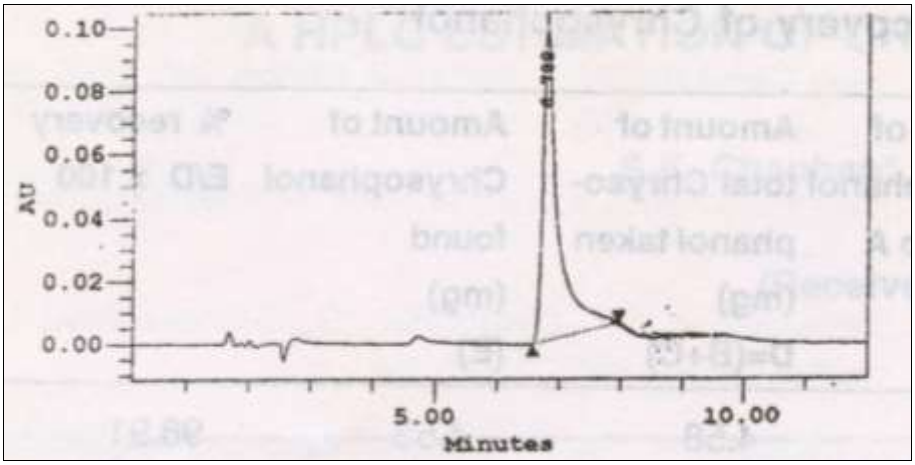


Fig 1: HPLC Chromatogram of Standard chrysophanol

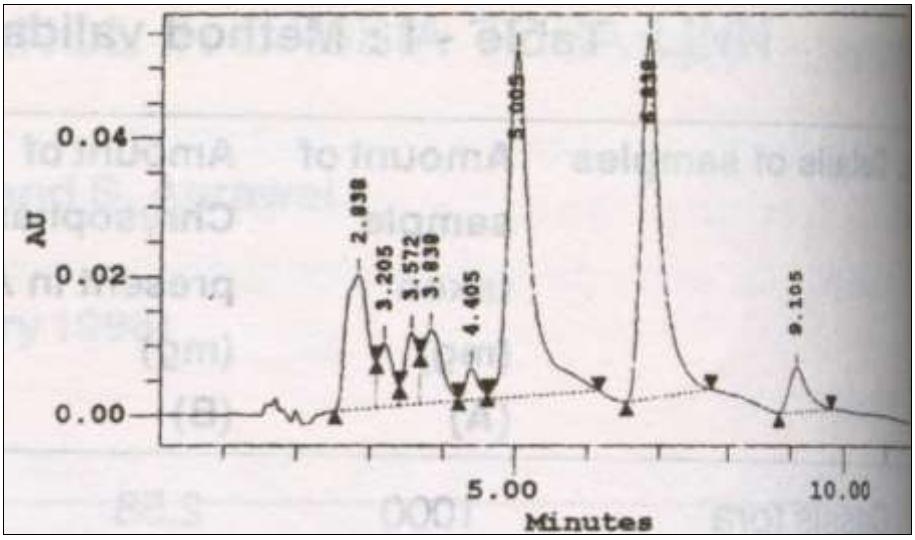


Fig 2: HPLC Chromatogram of C. tora

The chromatogram of standard chrysophanol and test sample have been shown in the above fig.-1 and 2. The average chrysophanol content in test sample was found to be 0.258% w/w, which is significantly based on the particle size of the test material. The particle size of 40# was found to be optimum.

The proposed HPLC method is rapid, simple, and reproducible for quantitative monitoring of chrysophanol and can easily be used for standardization of *Cassia tora* [17].

Clinical trials

Each of 2 groups of 19 unsexed Arbor Acres chickens got one of 4 diets for 6 weeks. One diet was of the usual ingredients; in 2 others 15 or 30% mango seed kernels replaced rice polish. A 4th diet had 30% mango seed kernels as well as 12% *Cassia tora* seeds, 10% tamarind seeds, 10% tomato waste and 5% penicillin mycelium residue. Birds on the diets in that order gained weight 656, 549, 453 and 249 g. Diets were changed after 6 weeks from an energy: protein ratio of about 132:1 to one of about 155:1. The last 3 diets then all had 15% mango seed kernels. The 3rd and 4th had 15 and 10% *C. tora* seeds and the 4th also had 10% tomato waste and 5% penicillin mycelium residue. Birds on those 4 diets gained 1196, 1133, 1059 and 873 g over the 12 weeks the experiment lasted. Results indicated that mango or *C. tora* seed could be given at 30% of diet but tamarind seed caused heavy mortality and poor growth even in lower proportions. The unconventional feeds were more efficient in finisher than in starter diets [18].

The nutritional potential of a number of raw tropical seeds was assessed in a series of feeding trials with rats. Seed lectin reactivity was also monitored. Alpha-amylase and trypsin inhibitory activities were determined in some of the seeds. *Albizia adinocephala*, *Albizia lebbeck*, *Bauhinia violacea*, *Cassia nodosa*, *Cassia tora*, *Dioclea sclerocarpa*, *Entada phaseoloides*, *Enterolobium cyclocarpum*, *Leucaena leucocephala* and *Moringa oleifera*: seeds were also highly toxic but had only low levels of non-toxic lectins suggesting that the toxicity was due to other anti-nutritional factors [19].

Toxicity

Toxicological screening was carried out on seeds of five wild Leguminous plants: *Delonix regia*, *Cassia tora*, *Sesbania sesban*, *Crotalaria naragutensis* and *Tamarindus indica.* The animals used in the toxicological screening were mice and rats. The seeds have high protein contents which range between 21.1% for *S. sesban* and 47.7% for *C. naragutensis*, while the mineral elements detected in appreciable quantities were calcium, magnesium, potassium, iron, cooper, zinc, phosphorus, and sodium. Oxalate content was very low, and they range between 0.03% for *S. sesban* and 0.09% for *C. tora.* Acute toxicity tests for 12 days using mice and rats given water extracts of the five legumes through the oral and intraperitoneal routes produced no visible negative effects. The treatment instead resulted in increases in fresh weights of the rats and mice when compared with the control animals

that were fed or injected with distilled water. There were also increases in blood sera protein and sugar contents of rats injected intraperitoneally with concentrated water extracts. Similar results were obtained in the prolonged toxicity screening.

Ayurvedik formulation

- **Product Name:** Blood Vigour Liquid
- **Composition:** Each 29 ml of fluid contains the extract of:
- **Hemidesmus indicus (Anantmula):** 3.3gm
- ***Cassia tora* (Chakramarda):** 0.6 gm
- **Melia azadirach (Nimbu):** 0.6 gm
- **Psoralea corylifolia (Bawachi):** 0.3 gm
- **Acacia catechu (Khadir):** 1.0 gm
- **Smilax china (Chobchini):** 0.2 gm
- **Coculus cordifolicus:** 0.3 gm

Dosage

Adults: 2 to 3 teaspoonfuls thrice daily with water after meals.

Children: 5 to 30 drops thrice daily with water after meals or as directed by the physician.

- **How supplied:** Bottles of 225 ml [21].
- **Product Name:** *Cutis Capsule*
- **Composition:** Each 500 mg Capsule contains:
- **Gandhak rasayan:** 100 mg
- **Azardirachta indica (Neem) extract:** 70 mg
- **Rubia cordifolia (Mangista) extract:** 70 mg
- **Mimosa pudica (Lajalu) extract:** 70 mg
- ***Cassia tora* (Chakramarda) extract:** 50 mg
- **Psoralea cordifolia (Bawchi) extract:** 50 mg
- **Argemone mexicana (Panchang) ext.:** 50 mg
- **Berberis aristata (Rasanjan)**: 40 mg

Dosage: One capsule two to three times a day preferably with milk after meals or as directed by the physician.

How supplied: Available in blister pack of 10 by 10 capsule. Economy pack of 250 capsule [21].

Product Name: Epidermoil Oil

Composition

- **Chakramarda:** 277 mg **(I)**
- **Nimbachhal:** 277 mg **(II)**
- **Chiraita:** 277 mg
- **Haldi:** 277 mg
- **Drauhaldi:** 277 mg
- **Raktachandana:** 277 mg
- **Vaasa:** 277 mg
- **Harar:** 277 mg **(III)**
- **Baheda:** 277 mg **(IV)**
- **Aamla:** 277 mg
- **Chameli patra:** 277 mg

In fused aqueous extract from oil.

Dosage: Used externally only, Quantity sufficient to apply on affected part & massaged [21].

Other formulation

- Maharajaprasarini tailum
- Yastimadhukadi tailum
- Surasadi tailum

- **Product Name:** Surya Herbal Nourishing Cream (For external use only)

Composition

1. Dist of Ocimum sanctum
2. Dist. of Melia azadirachta
3. Dist of Cassia tora
4. Dist of Glycyrhhiza glabra
5. Dist of Jasminum angustifolium
6. Tankan (D.G.V.-III)
7. Oil of Triticum sativum
8. Base

Direction for use

Message gently into the skin with upwards & downwards strokes and removes with moist cotton wool.

Aim of the expeimental work

The drug is traditionally claimed to be effective in various skin diseases, eye diseases, ringworm, and itch. The anti-bacterial and antifungal study of *Cassia tora* seed extract has been done previously, hence we under look a study to initially find out activity of *Cassia tora* leaves extract on various gram +ve bacteria, gram –ve bacteria and fungi by employing different extracts of the plant leaves.

The study aimed in the direction

- To establish the efficiency of the extracts on various gram +ve and on various gram –ve bacteria by using agar cup – bore method. To find out the MIC (Minimum Inhibition Concentration) of extracts.
- To establish the efficiency of the extract on various fungi by using agar cup – bore method. To find out the MIC of the extracts.

Experimental work

Materials and Methods

Collection: Fresh plants of *Cassia tora* were collected from the roadside of Mahesana – Gozariya Highway, Ganpat Vidyanagar in September – October, year 2003. It was identified by the Pharmacognosy department of Shree S. K. Patel College of Pharmaceutical Education and Research, Ganpat Vidyanagar, Gujarat, India.

Drying

The fresh leaves were removed from the plants and air dried at first. Then leaves were dried at 50° –55°C in a tray dryer of the pharmacognosy department of the college. Care has been taken that; the drying temperatures did not exceed 60°C. All the dried leaves were powdered in the mixer and passed through 40# sieve. This powder was used in all extractions.

Extraction: 50 gram of the powder was extracted in 250 ml 100% methanol by cold maceration for 48 hours and filtered.
Another 50 gram of the powder was extracted in 250 ml 50% methanol by cold maceration for 48 hours and filtered.
The extracts obtained after filtration were first concentrated on a water bath and then dried to a constant weight at room temperature.

Organisms

- Staphylococcus aureus, Pseudomonas aeruginosa, Aspergillus niger and Candida albicans were procured from the microbiology department of Zydus Cadila Health Care Laboratories, Ahmedabad and maintained at

the microbiology department of the college.
- Nutrient broth (13 g) was dissolved in 1000 ml distilled water for the cultivation of organisms.
- The organisms were grown in a nutrient broth at 25 °C for 24 hours.
- The 24 hour old culture was used for the anti-bacterial and anti-fungal activity.

Anti-microbial screening

[A] Media used
- The experiments for testing anti-bacterial and anti-fungal activities of the extracts were conducted aseptically in the microbiology department of the college.
- The media used for anti-bacterial activity was Nutrient agar and Sabaurda`s Dextrose agar for anti-fungal activity.

[B] Sterilization
- Both the above media were sterilized by autoclaving at 121 °C, 15 PSI for 15 minutes.
- All the glassware were sterilized by dry heat at 160°C for 2 hours.
- The workplace and micropipette were disinfected by using 70% alcohol.

[C] CUP – Bore Method
- The previously poured culture and culture media were allowed to solidify.
- Holes were punched aseptically in the solidified media by using a 6 mm borrer.
- With the help of the micropipette standard solution, test solution and Control solution were poured into the cup in the quantity of 50 µl.

[D] Standard, Sample & Control
- Erythromycin 100 µg/ml as standard drug for antibacterial activity and Fluconazole 10 µg/ml as standard drug for antifungal activity.
- The 100% methanolic extract was dissolved in 100% methanol to a strength of 100 µg/ml.
- The 50% methanolic extract was dissolved in DMSO to obtain 100 µg/ml concentration.
- Methanol and DMSO were used as controls.

[E] Incubation
- The anti-bacterial experimental petridishes were incubated at 37 °C for 24 hour in an incubator.
- The anti-fungal experimental petridishes were incubated at 28 °C for 7 days.
- Zones of inhibition were recorded at appropriate times.

Results

Extractive Values
- **100% Methanolic Extract:** 04.68%
- **50% Methanolic Extract:** 12.38%

There were no significant anti-bacterial as well as anti-fungal activities observed in the concentration of 100 µg/ml.

A certain degree of anti-bacterial activity was observed in 100% methanolic extract in the concentration of 10 mg/ml, but it did not provide a measurable zone of inhibition.

Conclusion
- The aloe-emodin, Chrysophanol & rhein possess anti-bacterial activity and Aloe-emodin, Chrysophanic acid – 9 – anthrone & rhein possess antifungal activity has been previously reported by Dr. Duke *et al*. (1992) [8].
- All the above chemical constitutes were reported only in the seeds and not in the leaves, hence the leaf extracts did not give any anti-microbial activity.
- This study is only preliminary in its nature and scope.
- It is possible that the dose used in our experiment is insufficient to elicit any noticeable activity.
- Traditionally the seeds are reported to be important as anti-fungal drug. We did not include seed extracts in our study. It is quite likely that seeds but not leaves have the claimed therapeutic uses.

Acknowledgement

Author is very much thankful to Dr. K. Pundrikakshudu, Head of the Pharmacognosy department at S. K. Patel College of Pharmaceutical Education and Research, Gujarat, India for his guidance.

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