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## *Cassia alata* and *Cassia auriculata* – Review of their bioactive potential

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### ABSTRACT

Nature has been a powerful source of powerful medicines for thousands of years and number of modern drugs has been extracted and exploited from natural sources, for its use in traditional medicine. Traditional herbal medicines have a long history of use and are generally considered to be safer than synthetic drugs. Over 50% of all modern clinical drugs are natural products that play an important role in drug development in pharmaceutical industries. The present communication constitutes a review on the distribution, phytopharmacy, medicinal properties and pharmacological actions of *Cassia alata* and *Cassia auriculata*. These plants are known to contain various active principles of therapeutic value and to possess biological activity against a number of diseases.

**Keywords:** Phytopharmacy, medicinal properties, pharmacological actions, *Cassia alata*, *Cassia auriculata*.

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### INTRODUCTION

Medicinal plants are important to the global economy [114], as approximately 85% of traditional medicine preparations involve the use of plants or plant extracts [128]. Plants are an important source of medicines and play a key role in world health [25]. *Cassia alata* Linn. (Family, Caesalpinaceae) is an erect tropical annual herb that grows 2-3 m high with leather compounded leaves. It is widely distributed in the tropical countries, particularly America, India, Fiji, Indonesia, Malaysia, Brazil and Africa [47, 62]. It has different names like ringworm weed in English, dadmari in Hindi and cakramard in Sanskrit [19]. Plants have the great potential used in traditional medicine in pharmacopoeia drugs [108]. Plants produce the wide range of bioactive molecules, making rich source of different types of medicines. Most of the plant drugs are produced from natural sources or semi synthetic derivatives used in the traditional systems and used as a medicine [115]. Plant parts synthesize some chemicals in themselves which metabolize their physiological activities. Phytochemicals are used to cure disease in herbal and homeopathic medicine [80]. *C. alata* is one of the most important species of the genus *Cassia* which is rich in anthraquinones and polyphenols [91, 131]. Activity of the plants is associated with the presence of chemical

components such as phenols, tannins, saponins, alkaloids, steroids, flavonoids and carbohydrates. *Cassia leaf* maximum content of anthraquinone glycosides are collected in Summer (March-June) and Winter (November-February) seasons [128]. Traditionally this plant is effective in treating skin infections in man [49] and animals. In many countries fresh leaves of *Cassia alata* used in the treatment of skin diseases such as ringworm, eczema, pruritis, itching, scabies, ulcers and other related disease [95, 100]. The seed is used as antihelminthic, the roots are used against uterus disorder, and the crushed leaves are used for skin infections [45]. All parts of this plant have one or more medicinal action especially antimicrobial activity [70]. Leaves are used in preparation of herbal formulations such as herbal tea, extracts, tincture, herbal soaps and shampoos. The extracts of *C. alata* have been used in cosmetic formulation for dermatological skin care products [38]. Usually dehydrated leaves of *Cassia alata* are marketed under the trade name 'Ringworm Cassia' [9, 82].

*Cassia auriculata* commonly known as Tanner's Cassia is an important medicinal shrub used in Asia [92]. *C. auriculata* (family: Caesalpinaceae), profoundly used in tonic, astringent and as a remedy for diabetes, conjunctivitis and ophthalmia.

The flowers are used widely used in Ayurveda tradition system used as A varaipanchanga chooranum and the main constituents of Kalpa herbal tea [16]. The flowers are used to treat urinary discharges, nocturnal emissions and throat irritation [124]. Flowers crushed and taken with goats milk to prevent white discharge in women. The root of the plant is used in decoction as alternative as well as medicinal oil prepared from the bark in Tamil called as averai – yennai. Root powder acts as a coagulant, prevents diarrhea, dysentery and fruit juice – indigestion. It gives relief against skin ailments [98]. The leaves infused yield a cooling drink and ground to paste with water the seeds of Phaseolusradiatus and poppy seed they are applied for therapeutic purpose [29].

The *cassia auriculata* plant contain preliminary phytochemical constituents such as alkaloids, phenols, glycosides, flavonoids, tannins, saponins, proteins, carbohydrates and anthraquinone derivatives are responsible for the pharmacology activity. The plant has been widely used in traditional system of medicine as a cure for rheumatism[59]. The plant has been reported to possess antipyretic [124]hepatoprotective[63], antidiabetic, antiperoxidative and antihyperglycemic[67] and microbicidal activity[74].

#### DISTRIBUTION AND GEOGRAPHICAL SOURCE

It is an annual or biennial shrub found throughout India in open forests *cassia auriculata* is a native of India, Myanmar and Sri Lanka and has been successfully introduced into several African countries. South-east Asia, Malaysia, Papua New Guinea ,Australia ,Queensland, Northern Territory and Western Australia. *Cassia auriculata* in dry regions of central India, Western Peninsula and western Rajasthan[40]. *Cassia auriculata* is widely distributed even in poor soil in Sri Lanka, India, Burma and cultivated in tropics [71]

*Cassia alata* grows aggressively in areas where there is high water table. It prefers open areas and sunlight. Often forms thickets and grown as ornamental. *Sennaalata*(*Cassia alata*) Linn (Fabaceae) is an ornamental flowering plant [56]native to the Amazon Rainforest and can be found in Peru, Brazil, French Guiana, Guyana, Suriname, Venezuela and Colombia. Due to its beauty, it has cultivated in tropical Africa, tropical Asia, Australia, Mexico, the Caribbean islands, Melanesia, Polynesia, Hawaii and widely distributed throughout the different parts of India like, Chattisgarh, Maharashtra, West Bengal, Andhra Pradesh etc[103]. It grows well in forested areas of West Africa. In Indonesia, Philippines and

Thailand [91], this plant can be found all over the countries, sometimes cultivated for medicinal purposes[17]. After 3 months of planting, leaves are ready for harvest, but the best period for the best quality is about 6-7 months after planting [11]. South America found widely in tropical region, up to 1500 m, on waste places often along ditches[66].It grows everywhere in the state of West Bengal, India up to 6 ft tall[43].It is found wild as well as the cultivated ornamental plant throughout India[7,10].

#### PHYTOGRAPHY

The legume, *Cassia alata*, locally known as Gelenggang Besar is classified under the Class Caesalpiniaceae which belong to the Family Leguminosae and Sub-Family Fabaceae. It is very easily raised from seed and the coarse erect shrub stands up to 3 - 4 m tall. Leaf consists of 10-12 pairs of leaflets. Leaflets are dark green, about 7.2-11.2 cm in length, 3.1-8.4 cm in breadth (size increases from base to apex of rachis), opposite, oblong-obovate, papery with asymmetrical base, entire margin, retuse apex and uncostate reticulate venation. The lower surface of leaflet is more pubescent than that of upper one. Anatomically leaflet exhibits a dorsiventral structure. Upper and lower epidermiare covered with unicellular nonglandular and multicelled glandular trichomes. They show presence of mucilage cells, stomata, papillose, prismatic calcium oxalate crystals and leucoplasts[64].

The inflorescence consisting of yellow flowers, long pendunculate, erect dense oblong spike, crowded and overlapping. *C. alata* L. is a perfect and complete flower. Flowers are petals because of the indistinguishableness of the petals and sepals [96]and pseudo-papilionaceous (common among all sub-family members of Caesalpinioideae) [129]. There are two sets of sepals once a young bud is maturing and the outermost layer falls off as the flower matures and opens up. The flowers floral structure consisting of sepals, petals, and stamens fused together (a characteristic evident among members of family Fabaceae). Each flower has two long banana-shaped anthers (which are tetrasporangiate), 3 projections from its stigma, 4 stomiums that serve as the exit point of pollen, a nectar, and a long pointed stalk that will eventually become the fruit pod of the future seeds known as the Gynophore[119]. Membrane of pollen grains are smooth with the 2um thick exine and a finely articulate sexine with granulate muri and lumina.

An axis produces 4- winged pods (i.e. legume) which grows at about 6-12 inches containing 50-60 flattened, triangular seeds. At a young age, the pods

are green, but eventually harden and turn brown as they mature [96,129].

#### ANTIBACTERIAL ACTIVITY

oleanolic acid was isolated from *Cassia auriculata* methanolic leaf extract inhibit the growth of *Escherichia coli*, *Salmonella typhi*, *Proteus mirabilis* and *Klebsiella pneumoniae* [107]. *Cassia auriculata* petals collected rich fractions of flavonoids in methanol extract, Petroleum ether, ethylacetate, chloroform extract that inhibit the growth of *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa* and *Proteus vulgaris* [117]. *Cassia auriculata* root methanolic extract have the antimicrobial activity like *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli* compared with the Standard antibiotics [50]. *Cassia auriculata* root saponin rich fraction was collected that will inhibit the growth of *P. vesicularis*, *Streptococcus faecalis*, *Aeromonas hydrophila*, *Salmonella typhae*, *Staphylococcus cohnii*, *Serratia ficaria* and *E. coli* [118]. *Cassia auriculata* aqueous flower extract mixed with silver nitrate to formulate the cold cream effective to kill clinical pathogens such as *E. coli*, *P. aeruginosa*, *S. aureus*, and *S. epidermidis* [102]. *Cassia auriculata* leaves methanolic extract isolated 1,3,8, trihydroxy-6-methyl-anthraquinone this is the bioactive molecule consent against the oral microflora [41]. 3,4-dihydroxycinnamic acid was isolated from *Cassia alata* had antibacterial activity against four Gram-positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis*, *Streptococcus pyogenes* and *Bacillus megaterium*) and four Gram-negative bacteria (*Shigella flexneri*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella typhi*) [19]. The cannabinoid dronabinol alkaloid isolated from the seeds of *C. alata* inhibited the growth of *S. aureus*, *P. aeruginosa* and *E. coli* [32]. Aqueous, methanol and chloroform crude extracts of leaves and roots inhibited the growth of *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Proteus mirabilis*, [36]. Kaempferol-O-diglycoside, quercetin-O-glucoside, kaempferol-O-glucoside, kaempferol, rhein, and danthron was isolated from *Cassia alata* leaves inhibited biofilm formation in *S. epidermidis* and *P. aeruginosa*. [105]. Aqueous, methanol and acetone root and leaf extracts inhibited the growth of *Escherichia coli*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella flexneri*, *Staphylococcus aureus* and *Streptococcus Pyogenes* [34].

#### ANTIFUNGAL ACTIVITY

Chloroform leaf extract of *Cassia alata* was more active against *Trichophyton mentagrophytes* and

ethyl acetate leaf extract was most effective against *Candida albicans* [51]. Methanolic leaf extract showed high activity against *Mucor*, *Rhizopus* and *Aspergillus niger* than ethanolic and petroleum ether extracts [90]. Ethanolic leaf extract of *Sennaplant* showed high activity against (dermophytic fungi) *Trichophyton mentagrophytes var. interdigitale*, *T. Mentagrophytes var. mentagrophytes*, *T. rubrum* and *Microsporium gypseum* and *Microsporium canis* [48]. Aqueous and ethanolic leaf extracts exhibit a greater antifungal activity against *Candida albicans*, *Microsporium canis* and *Trichophyton mentagrophyte* better than ketoconazole [122]. Methanol extracts from leaves of *Cassia alata*, *Cassia fistula* and *Cassia tora* were investigated for their antifungal activity, among 3 species, *C. alata* was the most effective leaf extract against *T. rubrum* and *M. gypseum* by extract treated hyphae and macroconidia were shrunken and collapsed [113]. Aqueous flower extract of *C. alata* is an antifungal agent for inhibitor of growth of aflatoxin producing fungi (*Aspergillus flavus* and *A. parasiticus*), plant pathogenic fungi (*Fusarium oxysporum* and *Helminthosporium oryzae*) and human pathogenic fungi (*Candida albicans* and *Microsporium audouinii*) [2]. Aqueous, methanol and acetone root and leaf extracts inhibited the growth of *Aspergillus flavus*, *Aspergillus niger*, and *Candida albicans* [34]. Cannabinoid dronabinol alkaloid isolated from the seeds of *C. alata* inhibited the growth of *A. niger* and *C. albicans* [32]. The chronic fungal disease, *Pityriasis versicolor* was cured without recurrence for 1 year by using aqueous extracts of fresh leaves of *S. alata* [28].

Chloroform extract of *Cassia auriculata* exhibit a greater antifungal activity against *Candida albicans* and *Aspergillus niger* [29]. *Cassia auriculata* leaf Methanolic extract having the greater antifungal activity in *Candida albicans*, followed by *Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus niger*, *Candida tropicalis* and *Candida cruzi* the least antifungal activity in *Penicillium sp* [107]. *Cassia auriculata* leaf extract silver nanoparticles polyphenols with aromatic rings are involved inhibit the growth of fungal strains *Aspergillus niger* and *Aspergillus flavus* [12].

#### ANTIOXIDANT EFFECT

The *Cassia auriculata* flower and leaf having the antioxidant activity methanolic extract of *Cassia auriculata* having the highest activity than the standard ascorbic acid and rutin, leaves and flowers having the lowest antioxidant activity [120]. *Cassia auriculata* Flower buds methanolic extract

exhibited higher presence of the most abundant dietary content present flavonol, Quercetin[54].

Ethanol extracts of *Cassia alata* showed strong antioxidant properties against hydrogen peroxide and superoxide anion [21]. 1-(4'-hydroxyphenyl)-2,4,6-trihydroxy-indole-3-carboxylic acid was isolated from *Cassia alata* ethyl acetate fraction exhibited a strong DPPH radical scavenging activity[36]. Redox properties of Phenol and flavonoids play an important role in absorbing and neutralizing free radicals[22]. Presence of phenols, anthraquinones, flavonoids, carotenoids, Vitamin-C and Vitamin-A in the methanolic leaf extract of *C. alata* indicates strong DPPH radical scavenging activity [103].

#### WOUND HEALING ACTIVITY

Wounds are the physical injuries that result in an opening and breaking of the skin and appropriate method for healing of the wound is essential for the restoration of the disrupted anatomical continuity and disturbed functional status of the skin[73]. The ethanol extracts of leaves of *S. alata* were investigated on excision wound model in Rats by, the leaf extract accelerated the wound healing potential by reducing the epithelialisation period, prevent high risk of sepsis and prolongation of inflammatory phase. [76].

*Cassia auriculata* ethanol and aqueous extract having proteins or chemotactic factors involved in the wound healing activity [65].

#### ANTIDIABETIC ACTIVITY

*Cassia auriculata* bark hexane, ethyl acetate and aqueous extracts increased level of insulin and C-peptide remnant  $\beta$ -cells in the pancreas[26]. *cassia auriculata* alcoholic extract leaves 3-O-Methyl-D-glucose (3-OMG) a nontoxic non metabolizable derivative of glucose, is effective in reducing the toxicity of streptozotocin (SZ)[8]. *cassia auriculata* flower n-butanol fraction was collected propanoic acid 2-(3-acetoxy- 4,4,14-trimethylandro-8-en-17-yl) (protein tyrosine phosphatase) 1B inhibitory activity assess the antidiabetic activity[125].

Ethyl acetate leaf extract showed hypoglycaemic activity[51]. The methanol extract exhibited antidiabetic activity by inhibiting  $\alpha$ -glucosidase activity [123].

#### ANTI INFLAMMATORY ACTIVITY

*Cassia auriculata* flowers methanolic extract containing flavonoids and bioflavonoids activity inhibition of lipid peroxides and decreased levels of lysosomal enzymes seems to have a high anti-inflammatory activity. *cassia auriculata* leaves of alcoholic extract possess DL- $\alpha$ -tocopheryl- $\alpha$ -D-mannopyranoside and DL- $\alpha$ -tocopheryl- $\beta$ -D-galactopyranoside having the antiallergic and

antiinflammatory activities[8]. 5-O-methylquercetin 7-O-glucoside was isolated from *Cassia auriculata* flower exhibited anti-inflammatory activity[71].

Hexane and ethyl acetate leaf extracts exhibited antiinflammatory activity in carrageenan-induced inflammation[51]. Kaempferol-3-O-gentiobioside (K3G) flavonoid glycoside isolated from *Cassia alata* leaves have anti-inflammatory activity [79].

#### ANTI CORROSION ACTIVITY

*Cassia auriculata* leaves refluxed dried concentrated powder prepared using 1NaOH solution the alkaloid compounds Luteolin, Quercetin, and hydroxyl group Kaempferol, Kaempferol-3-o-rutinoside are commonly present *cassia auriculata* leaves these compounds involved inhibit the aluminium corrosion activity[110]. Corrosion inhibition of chemical inhibitor has been found to be more expensive, highly toxic, non bio-degradable and very harmful to the living things. *Cassia alata* leaves has shown excellent corrosion inhibition performance for aluminium in 0.5 M HCl Solution[94]. Leaves of *Cassia alata* acted as good corrosion control in mild steel[68].

#### ANTICANCER ACTIVITY

4-(4-chlorobenzyl)-2,3,4,5,6,7-hexahydro-7-(2-ethoxyphenyl)benzo[h][1,4,7]triazecin-8(1H)-one compound was isolated from *cassia auriculata* leaf ethanolic extract in 48 hours 50% inhibit the growth of human colon cancer cells[37]. Flavonoids are present in fresh and dry leaf extracts of the plant but absent in seed extracts. They are a group of polyphenolic compounds have anti-cancer [104], antioxidant, anti-inflammatory [87,88] antimutagenic and antimicrobial activities[69].

#### WOUND HEALING ACTIVITY

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#### TREAT SKIN INFECTIONS

Aqueous extract of leaves of *Senna alata* were used to treat eczema, itching and skin infections in humans [78,85,91]. Applications of ointment prepared with the three ethanolic leaf extracts (*Cassia alata*. (Fabaceae), *L. camara* (Verbenaceae) and *M. scaber* (Rubiaceae) were effective in curing bovine dermatophilosis. The

ointment reached the affected area directly and penetrated the epidermis of the skin, falling off of the crusts and quickly inhibited the development of *D. congolensis* [6].

#### **ANTIMALARIAL ACTIVITY**

Malaria is a parasitic disease caused by a protozoan of the genus Plasmodium and transmitted by Anopheles mosquito vectors. Methanolic extract had higher antiparasmodial activity than the aqueous extract. Inhibition of *P. falciparum* growth was increasing concentrations of extracts [126].

#### **HEPATOPROTECTIVE ACTIVITY**

Hepatotoxicity was increase in the activities of serum marker enzymes namely serum alanine transaminase (ALT), serum aspartate transaminase (AST) , serum alkaline phosphatase (ALP) and bilirubin. Aqueous extract of the leaves of *Cassia alata* has hepatoprotective activity [33]. Crude extracts of *Cassia alata* petals have hepatoprotective effect by decreasing the levels of Serum aspartate aminotransferase and alanine aminotransferase in carbon tetrachloride (CCl<sub>4</sub>) – induced hepatotoxicity in rats[130]. *S. alata* have significant antioxidant and hepatoprotective effects on CCl<sub>4</sub>-induced hepatic damage in rats. A possible mechanism of hepatoprotective action of leaves of *S. alata* may be the antioxidant effect impairs the activation of carbon tetrachloride into the reactive form[58].

#### **ANTI-INFLAMMATORY ACTIVITY**

Hexane and ethyl acetate leaf extracts exhibited antiinflammatory activity in carrageenan-induced inflammation[51]. Kaempferol-3-O-gentiobioside (K3G) flavoniod glycoside isolated from *Cassia alata* leaves have anti-inflammatory activity [79]. 5-O-methylquercetin 7-O-glucoside was isolated from *Cassia auriculata* flower exhibited anti-inflammatory activity[71].

#### **HYPOGLYCEMIC ACTIVITY**

Ethyl acetate leaf extract showed hypoglycaemic activity[51]. The methanol extract exhibited antidiabetic activity by inhibiting  $\alpha$ -glucosidase activity [123].

#### **ANTIMUTAGENIC ACTIVITY**

Chloroform leaf extract, inhibited the mutagenicity of tetracycline exhibited antimutagenic activity [50].

#### **ANTI ULCERATIVE ACTIVITY**

cassiaauriculata leaf methanolic extract used to detect the anti-ulcer activity compared with the standard drug famotidine [77].These activities of MECA are attributed tannins and flavonoids.

#### **ANTI-CRYPTOCOCCUS ACTIVITY**

Combination of ethanolic extracts of leaves of *Cassia alata* and *Ocimum sanctum* showed anti-Cryptococcus activity [97].

#### **INSECTICIDAL ACTIVITY**

The pulse beetle *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) is the most widespread and a dreadful pest of stored legumes. Hexane extract of *Cassia alata* fruits cause high lethality and toxic to control insect pests. Cut down the glycogen, protein DNA, RNA amino acids and lipid content cause physiological imbalance in *C. chinensis* leads to death[99].

#### **ANTIALLERGIC ACTIVITY**

Compounds inhibiting lipooxygenases can be employed in the treatment of allergy/asthma[112]. Chemical constituents rhein (rhein exhibited lipooxygenase inhibitory activity) and kaempferol from *Cassia alata* leaves exhibited antiallergic activity via inhibition of mast cell degranulation and lipooxygenase inhibition [18].

#### **BRONCHORELAXANT EFFECT**

Aqueous-ethanolic extract of *Cassia alata* produce relaxation of tracheal smooth muscles exhibits bronchorelaxant effect[89].

#### **ANTIGENOTOXIC EFFECT:**

Genotoxic studies are useful to identify the level of DNA damage induced by xenobiotics. The antigenotoxic potential of was evaluated by aqueous-ethanolic extract of *Cassia alata* did not induce DNA migration [89].

#### **ANALGESIC ACTIVITY:**

Kaempferol 3-O-sophoroside was isolated from the leaves of *Cassia alata* exhibited analgesic activity [90].The hexane, chloroform and ethyl acetate extract of the leaves of *Cassia alata* exhibits analgesic activity [51].

#### **CHOLERETIC ACTIVITY:**

The Choloretic activity of *Cassia alata* extract proved to be better than that of hydroxycyclohexenyl-butyrate (Hebucol) a synthetic, choloretic in rats [13].

#### **DISSCUSSION:**

Plants are used for traditional medicine to treat chronic as well as infectious diseases [4]. Plant based antimicrobial compounds have great therapeutic potential as they can serve the purpose without any side effects often associated with synthetic drugs and also little chance of development of resistance. The common view in the society and the medical community is that plant

based products are healthier, safer, and more reliable than synthetic products[20].

*Cassia auriculata* lin, member of genus cassia belonging to family caesalpinaceae is commonly known as Taner's cassia [83]. In Ayurveda cassia auriculata used as a Matara Tea, under which name Trimen's of Flora of the people in the dry zone drink it as a remedy for malaria or other fevers(DrSeela Fernando)The most important of these bioactive principles are alkaloids, phenolic compounds, flavanoids and tannins that may be evolved in plants as self defence against pests and pathogens[116]. The *Cassia auriculata* flower showed the presence of alkaloids, tannins, flavonoids and anthroquinones while, saponins was not detected [55].*Cassia auriculata* root and leaf sample which exhibited the presence of anthroquinones, alkaloids, flavonoids, steroids, tannins and phenolic compounds[15]. Phytochemicals from medicinal plants showing antimicrobial activities have the potential components have the microbial sources[31]. *Cassia auriculata* flowers mainly used in hair products , dandruff treatment, hair dye product[75].The mainly phytochemicals are involved due to the many activity they also used as antipyretic, antiulcer and in the treatment of skin infections the flower has been reported to contain flavonoids, proanthocyanidins and  $\beta$ -sitosterol[98]. Diabetes mellitus is one of the major threats to human health in 21st century. It has been an explosive increase in the number of people diagnosed with diabetes worldwide[93].Ayurvedicmedicine, it is widely used for the control of sugar levels and reduction of symptoms like polyuria and thirst in diabetics [81]. Mainly the cassia auriculata flower was traditionally used as a diabetes the scientifically they proved as a hyper glycemc activity instreptozotocin induced animals[53].Aqueous and ethanol extract brought about its hypoglycemic action may be due to enhanced transport of blood glucose to peripheral tissue or by increase secretion of insulin from $\beta$ -cell of islets[23].procyandins could be responsible for the antidiabetic activity[72].Mainly the ethanolic extract of flowers of *Cassia auriculata* showed significant antioxidant activity[120].*Cassia auriculata* bark extract was used as a natural pollution bio absorbents water quality analysis[30].

The laxative and anti-tumor effects of the plant are due to the presence of anthraquinones. Alkaloids are bitter to taste and are toxic to other organisms. The antibacterial and antifungal properties of the plant may be due to the presence of alkaloids [42]. Flavonoids are present in fresh and dry leaf extracts of the plant but absent in seed extracts. They are a group of polyphenolic compounds have anti-cancer

[104],antioxidant, anti-inflammatory[87,88], antimutagenic and antimicrobial [69] activities.

Glycosides have an important role in Cardiac diseases[23].Phenols have the biological properties like antiapoptosis, antiageing, anticarcinogen, anti-inflammation and cell proliferating activities [44].Tannins have astringent properties, healing of wounds, anti-oxidant, antimicrobial and anti-inflammatory properties. The use of *S.alata* leaves directly for healing fungal infections has long been in practice. This property may be due to the presence of tannins. Tannins have astringent, anti-inflammatory, anti diarrheal, antioxidant and antimicrobial activities [57].

Saponins have traditionally used in detergents, pesticides and molluscicides in addition to their industrial applications such as foaming and surface active agents. They are help in controlling cardiovascular diseases and cholesterol in humans [5]. In industry, saponinshave a wide range of medicinal applications [109]. The leaf extract shows antibacterial, antifungal [112] anti-inflammatory and antioxidant properties [36]. *C. alata* leaf is also credited for the treatment of haemorrhoids, constipation, inguinal hernia, intestinal parasitosis, blennorrhagia, syphilis, diabetes [1,3,61], convulsion, gonorrhoea, heart failure, abdominal pains and oedema [86].The fresh leaves are squeezed and applied for ringworm, eczema, scabies, leucoderma, blotch, sores, mycosis, etc. [10,82,89,101].

According to Ayurvedic literature, leaves are sour and cure vata, cough, skin diseases, antipyretic, anti-inflammatory, antineoplastic, diuretic, purgative, abortifacient and antidiabetic agent.Extracts of higher plants have served as good sources of antibiotics against various bacterial and fungal pathogens [39].Extracts from dried or wet flowers and leaves of plants are applied as a paste on wound in some rural communities. The demonstration of the antimicrobial activity of *Sennaalata* in provides scientific basis for its use as a local health remedy. *Sennaalata* are used in the treatment of gastrointestinal, urinary tract wound infections andmycotic infections.

*Cassia alata* is one of the most commonly used herb in traditional medicine in various forms. Its therapeutic values as mentioned in Ayurvedic text leaves are antiparasitic, used in eczema, bronchitis, asthma, ringworm and in poisonous insect bites. Bark is used to treat skin diseases. Extract of aerial parts is CNS depressant, diuretic and anti-inflammatory [43] .It is widely used in India and Southeast Asia as traditional medicine[100].In Philippines it has been used in the form of herbal

tea, lotion and ointment for different purposes. The herbal tea (decoction of leaves and flowers) of *Cassia alata* is used as expectorant and to alleviate the symptoms of asthma attacks. The herbal lotion prepared from leaves is used for variety of skin diseases such as tinea infections, insect bites, ringworms, scabies, herpes, blotch, eczema and mycosis and purgative [56]. Andhra-Pradesh (commonly called as Simavisi), is used as a traditional medicine to treat bronchitis and asthma [106].

In Nigeria it is used for the treatment of ringworm and parasitic skin diseases[27,91]. The leaves are used to treating convulsion, gonorrhoea, heart failure, abdominal pains, oedema and

purgative[86]. In Suriname, root extracts from *C. alata* are used for the treatment of uterus disorders [46]. In Thailand *S.alata* has been listed in Thai traditional household drug for laxative and antifungal drugs. At present, *S.alata* is included in the list of Herbal Medicine Products A.D. 2006 of Thailand [84]. In Ghana it is used in the treatment of skin diseases. Coastal areas (especially the central region of Ghana) the leaves are in the treatment of liver problems [33]. It is commonly referred to as "Asuwonoyinbo" by the Yoruba ethnic group in Southwestern Nigeria [14, 52]. In the gold coast, its leaves are crushed, mixed with black pepper and are applied to dhoby-itch, craw-craw and ringworm on the head or skin[59].

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