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Review Article

Exploring The Therapeutic Potential Of Cassia Alata: A Comprehensive Review Of Its Pharmacological Attributes

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ABSTRACT

Around the world, Cassia alata is an important ornamental and medicinal plant that may be found in low to medium altitude tropical regions and is widely utilized in cuisine and traditional treatments. Notable phytochemical components include alkaloids, carbohydrates, flavonoids, phenols, tannins, steroids, and glycosides, among others. The purpose of this review is to provide light on C. alata's pharmacological properties and ethnobotanical description. Folk medicine has documented the use of several plant components as medicinal agents to treat a range of illnesses and infections. The pharmacological actions of the extracted chemicals and extracts showed significant activity. The plant's diverse parts may contain a range of secondary metabolites, including tannins, alkaloids, flavonoids, terpenes, anthraquinone, saponins, phenolics, cannabinoid alkaloids, 1,8-cineole, caryophyllene, limonene, α-selinene, β-caryophyllene, germacrene D, cinnamic acid, pyrazol-5-ol, methaqualone, isoquinoline, quinones, reducing sugars, steroids, and volatile oils that exhibit antibacterial, antioxidant,antifungal,dermatophytic,anticancer,hepatoprotective,antilipogenic,antihyperlipidemic,antimalarial, anthelmintic, and antiviral properties.

INTRODUCTION

It has been believed that medicinal plants, which have a wide range of biological uses, are the main sources of chemicals with therapeutic potential for the development of new therapeutic compounds. The isolation of new compounds and subsequent medication development are the normal outcomes of the quest for these chemicals in medicinal plants. Cassia alata is one of the medicinal plants having a variety of intriguing pharmacophores that have been the subject of scientific investigation. S. alata, sometimes called Cassia alata, is a herb belonging to the leguminosae family that grows widely. It is also referred to as ringworm plant,

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candle bush, craw-craw plant, akapulko, or ringworm bush. The plant, known by several local names, is widely distributed throughout Asia and Africa. Numerous bioactive chemical substances are present in it. The chemical ingredients that have been described include fatty acids (oleic, palmitic, and linoleic acids), steroids, terpenoids (sitosterol, stigma sterol, and campesterol), anthraquinones (alatinone and alatonal), and phenolics (rhein, chrysaphanol, kaempferol, aloeemodin, and glycosides). According to reports, these secondary metabolites exhibit a wide range of biological functions. The biological activity of the flower, root, leaves, seed, and bark were varied. Antifungal, antibacterial, antitumor, anti-inflammatory, antidiabetic, antioxidant, wound healing, and anthelmintic properties are among these pharmacological activities. Drug-resistant illness outbreaks in recent years have resulted in a number of health problems. Pharmacological research has been directed toward the development of novel, effective, and safe medications derived from natural substances in an effort to address these problems. This review evaluates C. alata's ethno botanical and pharmacological properties, supporting the plant's many traditional uses.

Taxonomy[2]

Kingdom:	Plantae
Subkingdom:	Viridiplantae
Infrakingdom:	Streptophyta
Super division:	Embryophyta
Division:	Tracheophyta
Subdivision:	Spermatophytina
Class:	Magnoliopsida
Superorder:	Rosanae
Order:	Fabales
Family:	Fabaceae
Genus:	Senna Mill.
Species:	Senna alata (L.) Roxb.
Synonyms:	Cassia alata L.

ETHNOBOTANICAL DESCRIPTION:

Description

Senna alata (L.) Roxb. The current name for the medicinal plant formerly known as Cassia alata (1753), is a member of the Fabaceae family. Calabra bush, Ringworm bush, and Candle bush are a few of its common English names. It is a smelly, 1-4 m tall, annual or biennial shrub that likes sunny, damp spots. The broad, yellowish-green leaves have five to fourteen leaflet pairs; the distal ones are frequently bigger and have a notched apex. Bright yellow flowers with a simple, erect raceme that resembles a dense golden spike or rod are called zygomorphic flowers. The golden blossom opens from the base to the top. There is a vertical column made out of the petals. The fruit is a 10–16 × 1.5 cm tetragonal pod with wings on the angles. When it is ripe, it is brown and contains many (up to 60) brown seeds in the shape of diamonds. Each winged seed pod has four sides and ranges in colour from dark purple to black. The pod is 2.8 cm wide and 25 cm long. It has 50–60 square to triangular seeds within. When the seeds are not mature, they are green in colour; when they ripen, they turn black. A rachis serves as the primary stem of a complex leaf in C. alata. The leaf is oblong, measuring roughly 5–16 cm in length and 3–8 cm in width. They come in six to twelve pairs. They have a pubescent ovary and seven stamens, two of which are significantly longer. Additionally, the leaves are specifically used to treat insect bites, athlete's foot, ringworm, eczema, and scabies. Native to tropical America, akapulko is a small, quickly growing tree that grows across the Philippines at low and medium elevations. It is cultivated and planted in populated areas for both aesthetic and medicinal purposes. Because C. alata has a low moisture content, dried leaves and blossoms can be kept for a few days without causing any physiological or biochemical reactions.

Geographical Distribution

C. alata is found throughout Africa, including in Ghana, Brazil, Australia, Egypt, India, Somalia, and Sri Lanka. This plant is native to the Amazon Rainforest and is used as a decoration. It is grown in humid and tropical areas of Africa, Asia, West Indies, Mexico, Australia, South America, the Caribbean Islands, Polynesia, Hawaii, Melanesia, and various parts of India, just like other Senna species. This shrub is planted for therapeutic uses and is extensively distributed in the Philippines, Indonesia, and Thailand.

Various parts of the plant used in traditional medicine3

Whole plant	In Cuba, medical treatments include: Diuretic Laxative for constipation Skin infections such as herpes ulcers in Guatemala, Brazil, and Guinea, it is used for flu and malaria treatment.
Leaves	In Tanzania, Ghana, India, Indonesia, and Africa, the leaves are prepared as an infusion and decoction to treat constipation. The leaves are rubbed on the surface of the skin for the management of various skin diseases. • Antifungal effect: management of ringworm and white-spot fungal skin infections. • Antipruritic: reduction of itchiness and rashes Antiviral: treatment against herpes simplex virus. • Immunomodulatory: Regulation of the production of white blood cells. Over-stimulated white blood cells production may cause psoriasis. In Nigeria, the fresh sap of leaves is rubbed into the skin for antifungal and ringworm treatment. The leaf decoction is also used for chronic lichen dermatitis management. In the Philippines, *C. alata* leaves are used on the skin for antibacterial, anti-inflammatory, analgesic and antifungal effects. The plant is also consumed to reduce blood glucose. In India, the leaf decoction is used as: • An expectorant for the treatment of shortness of breath and bronchitis. • An astringent: A skin wash for eczema. • To relieve discomfort associated with haemorrhoids. • For control of gastrointestinal parasitism. • To control blood glucose levels. In Brazil, the leaves are used to promote menstruation and improveblood circulation in female reproductive organs. In Egypt, a leaf decoction is used as a laxative to relieve constipation. In Sierra Leone, the leaves are prepared to relieve pain due to childbirth and abortion. In Thailand, leaf decoction (consisting of a minimum of 0.5% hydroxyanthracene derivatives) is used to relieve constipation.
Flowers	In Peru, an infusion prepared from flowers is used for diuretic and urinary tract infection treatment. In the Amazon, the Tikuna Indians prepare decoction of the flowers and consume them once daily to relieve constipation.

Seeds	In China, the seeds are made into a tea to improve eyesight and asthma.
Woods	Decoctions are consumed to reverse liver damage caused by hepatotoxins and to treat Wood gastrointestinal issues (e.g., loss of appetite). The leaves are ground into powder and rubbed directly on the skin to counteract problems correlated with fungal infections.

PHARMACOLOGICAL ACTIVITIES

The pharmacological properties of medicinal plants in the Fabaceae family have been the subject of much research. A wide variety of secondary metabolites are produced by plants, which support their medicinal properties. The pharmacological actions of C. alata are established and the ethno biological claims are validated by therapeutic assessment. Numerous publications have been made about the various therapeutic activities of C. alata. These activities are primarily associated with the following: antibacterial, antihyperlipidemic, antifungal, antilipogenic, antifungal, antioxidant, dermatophytic, antimalarial, anthelmintic, anti-inflammatory and wound healing.

1. **Antibacterial activities**

   According to Devillers et al. (1989), the antibacterial activity of the different extracts (petroleum ether, methanol, and aqueous) and aqueous fractions (ethyl acetate, diethyl ether, and aqueous) of C. alata leaves was examined against MRSA using the agar well diffusion process. Using this procedure, a sterile bottle containing nutrient broth was used to suspend a 24-hour-old MRSA culture. To achieve turbidity equal to the Marcfland standard 0.5, or around 108 cells/mL, normal saline was gradually added. The experiment's cell density was then adjusted to 106 cells/mL by diluting this. Next, for the antibacterial susceptibility test, 1 mL of the test organism (106 cells/mL) was seeded into Petri plates with a 90 mm diameter. Next, holes with a diameter of 6 mm and a depth of 4 mm were punched in the agar using a sterile cork borer. According to Hazni et al., the anti-microbial activity of kaempferol and its derivatives is contingent upon the presence of a free hydroxyl group at the C-3 position. The anti-microbial effectiveness of the kaempferol derivatives would also be impacted by the size of the R1 group. The antimicrobial potency decreases as the group size at the R1 location increases4. The minimum inhibitory concentration (MIC) or zone of inhibition (ZOI) are used to evaluate the antibacterial activity of medicinal plants. The methicillin-resistant S. aureus (MRSA), extended spectrum beta-lactamase, and carbapenemase-resistant bacteria were used to evaluate C. alata's in vivo antibacterial capabilities. Mueller-Hinton broth was used to isolate Enterobacteriaceae from infectious patients using the micro dilution method. Because of the analysis of flavonoids, quinones, tannins, sterols, alkaloids, and saponins, the extracts showed notable activity at 512 mg/ml5. According to a number of studies, the C. alata extract exhibited antibacterial activity against a variety of Gram-positive and harmful bacteria, including Escherichia coli, Pseudomonas aureus, Vibrio mimicus, Salmonella paratyphi, Vibrio parahaemolyticus, Vibrio cholera, Bacillus subtilis, Bacillus cereus, Shigella boydii, and Shigella dysenteriae. The antibacterial activity of C. alata (L.) Roxb extract was comparable to that of penicillin, chloramphenicol, fluconazole, and ciprofloxacin. It is caused by the secondary metabolite substances that cassia alata possesses, particularly the flavonoids, phenolics, and tannins6.

2. **Antioxidant properties**

The polyphenols found in abundance in C. alata have the potential to demonstrate potent scavenging ability against oxidative agents and free radicals, including hydrogen peroxide, superoxide anion, nitric oxide, 1, 1-diphenyl 2-picrylhydrazyl (DPPH), and 2,2-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) free radicals. It may also have strong reducing power and lipid peroxidation inhibition properties in addition to free radical scavenging. Malon dialdehyde (MDA) levels in the serum are typically greater in AD patients. Lipid peroxidation may result from MDA, an oxidant that xanthine oxidase provides. Excessive oxidative stress-induced redox imbalance may potentially play a role in the etiology. Sagnia et al. found that a decrease in MDA was observed in the Xanthine–Xanthine oxidase system. It was clarified that there was a correlation between the lowering power and the MDA decrease. The extract's phenolic and flavonoid concentration may show strong reducing power and hydrogen donation capacity, and they are crucial for managing AD. Sikora et al. created a thorough, moisturizing topical antioxidant solution containing C. alata and evaluated its effectiveness on humans in a recent pilot clinical research. The product's ability to shield skin from UV radiation-induced oxidative stress was demonstrated by the presence of lipid-soluble, enzymatic, and water-soluble antioxidants7.

3. **Antifungal properties**

A number of bioactive substances that have been isolated from C. alata have potent antifungal properties both in vivo and in vitro. The antifungal properties of dronabinol, 1,8-cineole, caryophyllene, limonene, α-selinene, β-caryophyllene, germacrene D, hexadecanoic acid methyl ester, and hexadecanoic acid can be found in (4-butylamine 10-methyl-6-hydroxy cannabinoid dronabinol)1,6,10-triene, octadecanoic acid methyl ester, cinnamic acid, -7,11-dimethyl-3 methylidenedodeca. Research has been done on isoquinoline, pyrazol-5-ol, flavonol and gallic acid, methaqualone, and 3, 7-dimethylocta-1, 6-diene8. The evaluation of C. alata flower volatile oils was conducted using standard strains and clinical isolates of aspergillus and candida.The examined microorganism's ability to thrive was greatly hindered by the oils. With a minimum inhibitory concentration (MIC) of 0.312 to 5 mg/ml, the methanolic extract, pure n-hexane, and ethanolic fractions of C. alata flower shown potent inhibitory effects against A. Niger, C. utilis, G. candidum, A. brevipes, and Penicillium species. The purified fractions did however show more pronounced inhibitory effects than the methanolic extracts at various doses. Similarly, the purified fractions greatly suppressed the growth of mycelia, resulting in a 100% suppression of sporulation for 96 hours at 2 mg/ml, while the methanolic extracts showed reduced sporulation after 48 hours9.

4. **Dermatophytic activity**

Nowadays, many types of skin infections and illnesses are treated with C. alata's leaves, blossoms, and bark. Cassia alata's anti-inflammatory and antibacterial qualities are primarily responsible for its anti-eczematic qualities. Compounds in the plant help lessen eczema-related inflammation, itching, and bacterial infections. The plant was included as one of the 54 medicinal plants in Thailand that are used to treat ringworm, pityriasis versicolor, urticarial infections, scabies, and itching.C. alata's dermatophytic activities are associated with bioactive substances like flavonoids, anthrones, anthranols, phenols, tannins, &derivatives of anthracene. Strong inhibitory activity against S. pyogenes, S. aureus, K. pneurnoniae, E. coli, S. marcescens, P. cepacia, and P. aeruginosa were demonstrated by the leaf decoction10, 11, 12, & 13. Apigenin, which was extracted from S. alata seeds, and the cannabinoid alkaloid 4-butylamine 10-methyl-6-hydroxy cannabinoid dronabinol were combined into a local antiseptic soap. Ringworms, eczemas, carbuncles, boils, infantile impetigo, and breast abscesses were all considerably inhibited by e soap. Strong inhibitory actions against the pathogenic organisms were demonstrated by the leaf, stem-bark, flower exudates, and ethanolic leaf extract when tested against clinical isolates of T. jirrucosum, M. canis, T. mentagrophyte, B. dermatitidis, A. flavus, and C. albicans. In vitro investigations of antibacterial qualities of Cassia alata leaf extracts were examined in a study which shows that Pseudomonas aeruginosa, Escherichia coli, and Staphylococcus aureus were significantly inhibited by the methanol and ethanol extracts. The results of the minimum inhibitory concentration (MIC) were similar to those of common antibiotics such as amoxicillin and ciprofloxacin14, 15.

5. **Antilipogenic, antidiabetic, and antihyperlipidemic activities**

Currently, C. alata leaves and flowers are used in Africa and Asia to control blood serum fat levels, obesity, and lipid absorption. In Wistar mice, aqueous leaf extract significantly decreased serum insulin, triglycerides, hepatic triglycerides, blood glucose, and serum cholesterol levels16. Diabetes poses a hazard to humankind, resulting in severe socioeconomic consequences and a high death rate. Using the inhibiting carbohydrate digesting mechanism, the antidiabetic potency of the acarbose, n-butanol, and ethyl acetate fractions of the methanolic C. alata leaf extract was evaluated.α-glucosidase is strongly inhibited by the antidiabetic medication acarbose, with an inhibitory concentration (IC50, 107.31±12.31µg/ml). The inhibitory activity of n-butanol and ethyl acetate fractions were found to be 25.80±2.01µg/ml and 2.95±0.47µg/ml, respectively, in response to kaempferol 3-O-gentiobioside, which was analyzed using Combiflash chromatography and HPLC17. DPPH free radical scavenging and antioxidant catalase assays were used to examine the decrease in oxidative stress in the aorta and heart of streptozotoc, hyperglycemic rats. Aqueous leaf extract was found to considerably lower blood glucose and lipid peroxidation (MDA levels); on the other hand, it was also found to improve the antioxidant catalase and DPPH free radical scavenging activity. The plant's ethnobiological claim was supported by the oxidative stress generated by heart dysfunction in hyperglycemic conditions being reversed. In a related investigation, the S. alata leaf extract dramatically lowers the oxidative stress that leads to diabetes in mice receiving treatment.Significant activity was seen in the liver and kidney.The activity caused significant alterations in the blood serum levels of urea, protein, creatinine, and uric acid18.

6. **Anti-malarial activity19**

Malaria poses a worldwide risk that exacerbates major health and social problems in humid and tropical areas. According to chemotherapy, quinones, alkaloids, and terpenes may be connected to C. alata's antimalarial properties. Using the Desjardin microdilution assay, quinones extracted from C. alata showed a strong in vitro antiplasmodial activity against Plasmodium falciparum. In ethylene glycol-water fractions, terpenes extracted from S. alata leaves shown strong antiplasmodial tests against P. falciparum. At concentrations less than 1µg/ml, significant action was seen. The evaluation of C. alata's aqueous leaf extract supports its ethno medical uses as a treatment for fever and malaria. In Wistar mice, the leaf extract significantly reduced the 3D7 strain of the P. falciparum parasite.

7. **Anthelmintic activity20**

Decoctions of C. alata leaves and flowers have long been used to treat stomach disorders and intestinal worm infestations. Using clinical isolates of Ascardia galli and Pheretima posthuma, the anthelmintic potency of alcoholic leaf extracts of C. alata and T. angustifolia at 10 to 100 mg/ml was evaluated by tracking the worm's paralysis and death points.C. alata contained glycosides and flavonoids, according to preliminary phytochemical screening of the alcoholic extract. At greater concentrations, the alcoholic extracts of the leaves of T. angustifolia and C. alata showed notable anthelmintic effects. The extract exhibited dose-dependent anthelmintic actions, with 100 mg/ml having the greatest effects against both types of worms and causing the shortest period of paralysis and death. In contrast to T. angustifolia extract, which demonstrated paralysis and death in 10 and 30 minutes against P. posthuma, the alcoholic extract of C. alata produced paralysis in 8 minutes and death in 28 minutes. The effects of the reference medication, piperazine citrate, were observed at 21 and 59 minutes, respectively. Additionally, Ascardia galli worms shown sensitivity to C. alata and T. angustifolia extracts. At a concentration of 100 mg/ml, the alcoholic C. alata extract resulted in paralysis in 5 minutes and death in 29 minutes, while the T. angustifolia extract showed paralysis and death in 6 and 27 minutes, respectively.

8. **Anti-inflammatory activity**

Additionally, C. alata demonstrated strong anti-inflammatory properties in a range of in vitro and in vivo settings. When mice were given C. alata extracts orally, anti-inflammatory efficacy was observed in the carrageenan-induced mouse paw oedema test. At 5mg/20g, the inflammatory activity was reduced. Lewis et al. provide evidence for this conclusion. The researchers found that C. alata leaves suppressed immature dendritic cells production of tumour necrosis factor-alpha (TNF-α) in a dose-dependent way. Acute inflammation results in the production of the inflammatory cytokine TNF. TNF-inhibitors found in C. alata leaves have the ability to reduce the body's natural reaction to an inflammatory response. The work by Riaz et al.Clearly shows that the inhibitors reduce the inflammatory response21. The anti-inflammatory related transcription factors, enzymes, and cytokines TNF-, cyclooxygenase-2 (COX-2), prostaglandin E2 (PGE2), matrix metalloproteinase-1(MMP-1), MMP-3, interleukin-1 (IL-1), IL-4, IL-6, IL-8, IL-13, and interferon-gamma can all be regulated by astragalin from C. alata. In C. alata, anthraquinones and flavonoids work well as anti-inflammatory drugs. Numerous researches have proven anti-inflammatory characteristics. Numerous research has been conducted on astragalin's anti-inflammatory properties. In addition, anti-inflammatory properties were shown by kaempferol, luteolin, apigenin, naringenin, rhein, chrysophanol, aloe emodin, emodin, and caffeic acid. Kaempferol inhibits the nuclear factor kappa light chain enhancer of activated B cells (NFK), mitogen-activated protein kinase (MAPK), and extracellular signal-regulated kinase (ERK), which are the three mechanisms via which the anti-inflammatory effect is targeted22.

9. Wound healing

Dermal and epidermal tissue naturally regenerates during the healing process. In reaction to tissue damage, a typical wound heals in three stages: the inflammatory, proliferative, and remodelling phases. As soon as the platelets come into touch with the exposed collagen at the damage site, the normal wound healing reaction starts. Patients who have skin flare-ups from atopic dermatitis (AD) go through an itching-scratching cycle. Because of their itching, people who scratch their rash too much harm their skin and take longer to heal. Persistent infections are caused by bacteria, viruses, and fungus entering the skin through open wounds. As a result, wound healing in AD patients is typically more difficult and involved than in healthy people. Anthraquinone, tannins, alkaloids, terpenoids, and flavonoids may all influence wound closure. Oleic acid and linoleic acid have the ability to control the expression of metalloproteinase, suppress leukocytes and cationic serine protease activity, adjust inflammatory responses in tissue repair, and stimulate angiogenesis and collagen synthesis in wound healing. Additionally, there is a strong correlation between C. alata's antimicrobial activity and wound healing. C. alata contains 3, 4-dihydroxycinnamic acid, which exhibits broad-spectrum antibacterial action against both Gram-positive and Gram-negative bacteria. These elements support patients' wound-healing processes23. In a previous study, using a rabbit wound healing model, Palanichamy et al. assessed the antibacterial activity of ethanolic leaf extracts from C. alata. In order to assess the effectiveness of the extract's antibacterial activity in wound closure, the wound was infected with S. aureus. Animals in the treatment group received an ointment containing C. alata leaf extract for a period of 21 days. The ointment application demonstrated acceptable wound healing, according to the authors. Over the course of the 21-day treatment, there was a considerable reduction in the wound surface area (58.8, 79.0, and 88.9% after 7, 14, and 21 days, respectively). After 21 days, the ointment-treated negative control group (which did not receive any antimicrobial agent) only shown a 57.1% decrease in wound surface area. After 14 days, the positive control group that received 0.2% nitrofurazone ointment had 98.8% less wound surface area. While C. alata leaf extract did not exhibit the same level of antibacterial and wound-healing activity as nitrofurazone, it is nevertheless a useful natural antimicrobial agent for the treatment of AD wounds24.

REFERENCE

1. Oluwole Solomon Oladeji et al. Ethno botanical Description and Biological Activities of Senna alata. Hindawi Evidence-Based Complementary and Alternative Medicine. 2020, Article ID 2580259, 12 pages.
2. Abille JM. A review on the medicinal plant cassia alata (l.) Roxb. (Fabaceae).
3. Yon, J.-A.-L.; Lee, S.-K.; Keng, J.-W.; Chow, S.-C.; Liew, K.-B.; Teo, S.-S.; Shaik Mossadeq, W.M.; Marriott, P.J.; Akowuah, G.A.; Ming, L.C. Cassia alata

(Linnaeus) Roxburgh for Skin: Natural Remedies for Atopic Dermatitis in Asia and Their Pharmacological Activities. Cosmetics 2023; 10(5).
4. Muhammad,S.L.; Wada, Y.; Mohammed, M.; Ibrahim, S.; Musa, K.Y.; Olonitola, O.S.; Ahmad, M.H.; Mustapha, S.; Rahman, Z.A.; Sha'aban, A. Bioassay-guided identification of bioactive compounds from Senna alata L. against methicillin-resistant Staphylococcus aureus. Applied Microbiology. 2021; 1, 520–536.
5. P. Wikaningtyas and E. Y. Sukandar, The antibacterial activity of selected plants towards resistant bacteria isolated from clinical specimens. Asian Pacific Journal of Tropical Biomedicine, 2016; 6(1), 16–19.
6. Fri Rahmawati, Nur Nunu Prihantini, and Bella Christina Hady. In Vitro Bioactivity Test of Senna Alata (L.) Roxb Leaves Extract. International Journal of Health Sciences and Research. 2022; 12(2).
7. Mohammed.A.R.; Ali, A.M.; Aboul-Enein, S.M.; Mohamed, F.M.; Abou, E.; Magdy, M.D.; Mohammed, A.R.H. Phytochemical, cytotoxicity and antioxidant investigation of Cassia alata leaves growing in Egypt. Journal of Innovations in Pharmaceutical and Biological Sciences. 2017; 4, 97–105.
8. D. E. Okwu and F. U. Nnamdi, Cannabinoid dronabinol alkaloid with antimicrobial activity from Cassia alata Linn, Der Chemica Sinica. 2011; 2(2), 247–254.
9. O. Adebayo, W. A. Anderson, and M. Moo-Young, Anti-fungal properties of some components of S. alata flower, Pharmaceutical Biology, vol. 37, no. 5, pp. 369–374, .
10. O. Neamsuvan. A survey of herbal formulas for skin dis eases from Tailand's three southern border provinces. Journal of Herbal Medicine.2015; 5(4), 190–198.
11. E. Ramstad, Modern Pharmacognosy, McGraw-Hill, New York, NY, USA, 1959.
12. S. H. Brown, S. alata, e Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, USA, 2011.
13. T. V. Benjamin and A. Lamikanra, Investigation of Cassia alata, a plant used in Nigeria in the treatment of skin dis eases. Quarterly Journal of Crude Drug Research. 1981; 19(2-3), 93–96.
14. A. A. Makinde, J. O. Igoli, L. TA Ama. Antimicrobial activity of Cassia alata, African Journal of Biotechnology. 2007; 6(13), 1509-1510.
15. N. Ali-Emmanuel, M. Moudachirou, J. A. Akakpo. Treatment of bovine dermatophilosis with Senna alata, Lantana camara and Mitracarpus scaber leaf extracts. Journal of Ethno pharmacology. 2003; 86, 167–217.
16. J. Naowaboot, N. Somparn, S. Saentaweesuk. Umbelliferone improves an impaired glucose and lipid metabolism in high-fat diet/streptozotocin-induced type 2 diabetic rats. Phytotherapy Research. 2015; 29, 1388–1395.
17. G. K. Varghese, L. V. Bose, and S. Habtemariam, Antidi abetic components of Cassia alata leaves: identification through α-glucosidase inhibition studies. Pharmaceutical Biology.2013; 51(3), 345–349.
18. M. Sugumar, D. Victor, A. Dossb. Hepato-renal protective effects of hydroethanolic extract of S. alata on enzymatic and nonenzymatic antioxidant systems in streptozotocin induced diabetic rats.

Integrative Medicine Research. 2016; 5, 276–283.

19. J. S. Kayembe, K. M. Taba, K. Ntumba et al., In vitro anti-malarial activity of 20 quinones isolated from four plants used by traditional healers in the Democratic Republic of Congo, Journal of Medicinal Plants Research. 2010; 4(11), 991–994.
20. Anbu J, Murali A, Sathiya R, Saraswathy GR, Azamthulla M. In Vitro Anthelmintic activity of leaf ethanolic extract of Cassia alata and Typha angustifolia. SASTech-Technical Journal of RUAS. 2015; 14(2): 41-4.
21. Villasenor, I.M.; Canlas, A.P.; Pascua, M.P.I.; Sabando, M.N.; Soliven, L.A.P. Bioactivity studies on Cassia alata Linn. Leaf extracts. Phytotherapy Research. 2002; 16, 93–96.
22. B. Sagnia, D. Fedeli, R. Casetti et al., Antioxidant and anti-inflammatory activities of extracts from C. alata, E. indica, E. speciosa, C. papaya and P. fulva medicinal plants collected in Cameroon. PLoSOne. 2014; 9(8). ArticleIDe103999.
23. Yon, J.-A.-L.; Lee, S.-K.; Keng, J.-W.; Chow, S.-C.; Liew, K.-B.; Teo, S.-S.; Shaik Mossadeq, W.M.; Marriott, P.J.; Akowuah, G.A.; Ming, L.C.; et al. Cassia alata (Linnaeus) Roxburgh for Skin: Natural Remedies for Atopic Dermatitis in Asia and Their Pharmacological Activities. Cosmetics. 2023; 10(5).
24. Palanichamy, S.; Nagarajan, S. Anti-inflammatory activity of Cassia alata leaf extract and kaempferol 3-O-sophoroside. Fitoterapia. 1990; 61, 44–47.

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