INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Article

A Review Of Therapeutical Potential Of Cassia Fistula In Diabetic Mellitus

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ARTICLE INFO

Published: 08 Nov. 2024
Keywords:
Deciduous, Yellow Blossoms, Astringent taste, Linear-oblong stipules, Pedicels, Distal mark, Ventral suture, Fine horizontal striations.
DOI:
10.5281/zenodo.14056088

ABSTRACT

The therapeutic potential of Cassia pistula (also known as Indian laburnum) in managing diabetic mellitus has garnered significant interest in recent years due to its medicinal properties. Several studies suggest that Cassia pistula possesses antidiabetic effects, attributed to its bioactive components, including flavonoids, anthraquinones, and saponins. These compounds are believed to influence glucose metabolism, improve insulin sensitivity, and reduce oxidative stress, all of which play key roles in the pathophysiology of diabetes. Experimental studies, primarily in animal models, have demonstrated that Cassia pistula extracts can lower blood glucose levels, enhance antioxidant defense systems, and protect pancreatic β-cells from damage. However, despite promising preclinical evidence, clinical trials on its safety and efficacy in humans remain limited. This review aims to synthesize current evidence on the antidiabetic potential of Cassia pistula and identify gaps for future research in order to better understand its role in diabetes management.

INTRODUCTION

Nature has supplied a variety of plant resources that are vital to animals. Many studies are currently being conducted to determine the nutritional and pharmacological benefits of plants for medical applications. [1,2] The well-known plant Cassia fistula, also called Golden Shower in English or amaltas in Hindi, grows up to 1300 meters in the outer Himalayas in deciduous forests. [3] Cassia fistula L., a member of the Fabaceae family in the Caesalpinioideae subfamily, is known for its medicinal qualities and grows semi-wild in its natural habitat. [4] It is found in many places, such as Asia, South Africa, China, the West Indies, and Brazil. Amultas, also called "Indian Laburnum" in English, is a plant that has been widely used in Ayurvedic medicine to treat a variety of ailments. It can reach elevations of 1300 meters in the outer Himalayas and is extensively utilized in Indian traditional medicine. Across most of India, it can be found in mixed-monsoon and deciduous forests. [5]

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Diabetes mellitus (DM) is a metabolic disease marked by abnormalities in protein, fat, and carbohydrate metabolism and persistently high blood sugar levels caused by issues with either insulin secretion, insulin function, or both.[6] Globally, the prevalence of DM is increasing. The International Diabetes Federation estimates that 415 million people worldwide had diabetes mellitus in 2015. It is anticipated that figure will increase to 642 million by 2040. Approximately 75% of people with diabetes reside in low- and middle-income nations. [7] The WHO predicts that diabetes will rank as the sixth most common cause of death by 2030. [8] The current treatments for the illness are expensive, have side effects, and only work in part.[9, 10] As a result, there is a growing need for hypoglycemia drugs that are more affordable, secure, and effective. Numerous Indian medicinal plants and herbs have been found to help control diabetes through a variety of techniques. [11,12] Numerous therapeutic uses exist for Cassia fistula, especially in conventional medicine. This alien species is a popular decorative plant because of its eye-catching yellow blossoms. The seeds of this plant are used to treat gastritis and diarrhea and as an insect repellent. The seeds are also used to reduce biliousness and boost appetite. Leprosy, syphilis, tuberculosis, and skin disorders are all treated with the roots [13]. Root extracts are also used to lessen burning sensations. Fruits can help with inflammation, rheumatism, asthma, liver issues, chest issues, and throat ailments. In Thai traditional medicine, the mature fruits are boiled in water and the resulting extract is filtered through a sieve to act as a laxative. [14]

1. Morphology:

Greenish-grey bark, compound leaves, and leaflets that are 5–12 cm long in pairs are characteristics of deciduous trees. Known for its lovely clusters of yellow blossoms, traditional medicine uses this partially tamed tree for a number of purposes. The fruit consists of a cylindrical pod with numerous transverse partitions that divide the sweet pulp surrounding the black seeds. As they mature, the long green pods turn black after dropping their blossoms. [16] The pulp is rather unpleasant, sticky, sweet, slimy, and has an odd odor. It has a dark brown hue. [17] [] The medication is often thick, flat, or curved, with warty areas and a smooth to rough exterior. Its color varies from red to greenish grey, and its inner surface is rough and reddish with parallel striations. It has a laminate fracture and a pleasant smell. The taste's astringency, which receives a score of [18]

A tall tree, 6 to 9 meters tall, with a straight trunk, thin, scattered branches, and smooth, pale grey bark that becomes rough and dark brown as it ages. Hairy primary rhachis and small, blunt, linear-oblong, hairy stipules adorn the 23–40 cm long leaves. The main veins on the underside are numerous, prominent, and closely spaced; the petiolules are smooth or hairy and 6-10 mm long; and the leaflets are 4-8 pairs, oval or oval-oblong, with a pointed tip, and measure 5-12.5 by 3.8-9.5 cm. When young, the lower side is lighter and silvery-hairy, while the upper side is smooth and bright green. Flowers are closely spaced in racemes that are 30 to 50 cm long, with pedicels that are 3.8 to 5.7 cm long. , thin, hairy, and smooth. The calyx has blunt, rectangular segments and is 1 cm long, with divisions toward the base. There are fine hairs all over it. Each stamen has anthers, and the yellow corolla has a diameter of 3.8 cm. The dark brown-black, glossy, nearly straight, cylindrical pods hang down without breaking apart. They have 40–100 flat seeds with a dark, delicious pulp covering them. The roughly oval seeds have dimensions of 8 mm in length, 5 mm in thickness, and a slightly smaller width. [19] The fruit pods measure 20–27 mm in diameter and 40–70 cm in length. They have fine horizontal striating that looks like tiny fractures and are either

straight or slightly curved. The small mark on the distal ends indicates the style's location. The dorsal suture is thought of as a single vascular strand, whereas the ventral suture is composed of two closely related strands. Inside the pod, there are thin, transverse, buff-colored partitions spaced about 0.5 cm apart. Each segment contains a single, flat, oval, reddish-brown seed with a noticeable raphe. Within the white endosperm of the seed is a yellow embryo. [20]

2. Taxonomic Position

Kingdom	*Plantae*
Subkingdom:	Tracheobinota
Super Division	Spermatophyta
Division	*Mangoliophyta*
Class	*Magnoliopsida*
Subclass	*Rosidae*
Order	*Fabales*
Family	*Fabacae*
Genous	*Cassia*
Species	*Fistula*

3. Vascular Classification

Bengali:	*amultash,sondal,sonali*
English	golden shower, Indian laburnum
Gujarati	Girmala
Hindi:	Bandarlathi,bharva,suvarnaka
Malayalam	Tengguli,rajah
Sanskrit:	saraphala,survanaka,argwadha ,rajtaru
Tamil:	kavani,konnai,tirukontai,sarakkonne
Telugu:	Kakkemara
Marathi:	Bahava
Punjabi	Amaltaas, Kaniyaar, Girdnalee
Oria	Sunaari
Urdu:	Amaltaas
Arab:	Khayarsambhar chaiyaphruek,khuun
Thai	Canâfístula mansa,chácara ,Guayaba
Spanish	Bâton casse, casse doux, casse espagnol

4. Traditional Medicinal Uses:

The root extract reduced blood sugar levels by as much as 30%.16. Root can aid with fever, cardiac issues, retained excretions, and biliousness.[21] The root is used to treat a variety of skin conditions, ulcers, boils, rheumatism, hemorrhages, wounds, and heart irregularities. [22] Stem bark is used to alleviate swellings, chest discomfort, and amenorrhea. Because of its tonic and antidysentric qualities, the bark is used to cure skin diseases. Its powder or decoction is also used to treat heart ailments, syphilis, leprosy, and jaundice. [23] For rheumatism, bug bites, facial paralysis, and chilblains, a poultice made from the laxative leaves is used topically as an emollient. [24, 25] Leaf juice can be used to cure ringworm by reducing pain and swelling in the afflicted regions. The fruit pulp that envelops the seeds has a little purgative effect.[27] astringent, bilious, and febrifugal. In female albino rats, a 50% ethanolic extract of the pods exerts antifertility properties. The heated pods are applied to cold-related neck swellings. There have been claims that the fruits can treat asthma. [28] In albino rats, the flower extract increases uterine activity while suppressing ovarian function. Fruits can be used to treat diabetes, as well as diseases of the eyes, throat, liver, chest, and grasping muscles. Along with its antipyretic, abortifacient, and demulcent qualities, they also reduce body heat and inflammation. [29] The seeds contain cathartic, emetic, and constipation-relieving qualities. The seeds contain cooling, laxative, carminative, appetite-boosting, and antipyretic properties. They also have a touch of sweetness.[30]



Image. cassia fistula plant

5. Phytochemical Composition

Numerous elements found in various Cassia fistula plant sections have been thoroughly examined. The plant contains essential stearic, linoleic, oleic, and carbohydrate acids. The main components of C. fistula leaves include glycosides, free rhein, sennosides A and B, isofavoneoxalic acids, and oxyanthraquinone derivatives. Lepeol, hexacosanol, tannins, and B-sitosterol are all present in the powdered stem bark. Arginine, protein (19.9%), and carbs (26.3%) Leucine, arginine, protein (19.9%), and flavonid-3-ol-subordinates are all present in C. fistula fruit pulp. The pods include gluten components, fistulic acids, kaempferol, and astringents. The seeds include malvalic acid, sterculic acid, and vernolic oil. Among the essential oils included in the flower are aurantimide, ceryl alcohol, kaempferol, anthraquinones, bianthraquinones, and glycosides. Furthermore, the tree's various sections have differing concentrations of 4-hydroxy benzoic acid, fistulin, unstable sections, phytol.

Table 1: phytochemical in different plant parts of cassia fistula linn

Cassia fistula [parts]	Primary and secondary metabolite
Seeds	Amino acids, galactomannan, Kaempferol, fistulin, triglycerides, vernolic acid, stetculic acid, furfural derivatives, oxyanthraquinones, galactomannan free sugars and amino acids.
Leaves	Sennoside A and B, Rhein, Tannins, nerolidol, hexadecanone, phytol, Volatile oils.
Flowers	Bianthraquinone glycosides, ceryl alcohol, aurantiamide acetate, rhein and volatile oils.
Pulp	Gluten Oxalates, oxyanthraquinones, albuminous starch, sugar, gum, astringent matter.
Root bark	Tannins, phlobaphenes, betulinic acid, rhamnetin 3-O-gentiobioside, oxyanthraquinone, 7- methylphyscion.
Pod	Sennoside A and B, Oxalic acid, rhein, 5-nonatetracontanone, anthraquinones derivatives.
Stem bark	Flavonol glycosides, Xanthone glycosides, dimethoxyflavone arabinopyranoside.
Fruit	Methionine, aspartic acid, leucine, catechin, 1,8-dihydroxy-3-methyl anthraquinones, Glutamic acid, 5-nonatetracontanone, triacontane.
Aril part	Isovanillic acid, palmitic acid, Oleic acid, sterols, stigmasterol, lupeol, emodin, ziganein, scopoletin.

(16.1%), gemstones, and 2-hexadecanone (12%).[21, 22]

6. Plants Investigated For Anti-Diabetic Activity:

6.1 Ferula assafoetida

Asthma, influenza, epilepsy, and digestive disorders are among the many ailments that have long been treated with asafoetida, a resin derived from the roots of the plant Ferula assafoetida. The hypoglycemic effects of Asafoetida were investigated in rats with diabetes caused by streptozotocin. The asafoetida extract had a significant hypoglycemic impact when administered at a concentration of 50 mg/kg for four weeks, suggesting the presence of tannins and phenolic acids (ferulic acid) in the extract. [23]

6.2 Stevia rebaudiana

The antidiabetic effects of an aqueous extract of Stevia rebaudiana were evaluated using a variety of polyherbal combinations, including Momordicha charantia, Tamarindus indica, Gymnema sylvestre, Allium sativum, and Murraya koenigii. In normal rats, these combinations were assessed for oral glucose tolerance, acute toxicity, anti-α amylase and α-glucosidase activity, antidiabetic effects, and liver function tests. Once

every combination was found to be safe, a dose of 250 mg/kg was chosen. Polyherbal combinations II had significant antidiabetic activity, suggesting that flavonoids, sterols, and tannins were included in this mixture. [24]

6.3 Adenanthera pavonina Linn

The antihyperglycemic and lipid-lowering effects of Adenanthera pavonina seed aqueous extract (APSAE) were tested in streptozotocin-induced diabetic rats. High blood triglyceride and cholesterol levels were dramatically lowered ($P<0.01$) after APSAE therapy, and plasma glucose levels significantly dropped ($P<0.01$). After 30 days of APSAE therapy, blood HDL cholesterol levels dramatically rose ($P<0.01$) while serum LDL cholesterol levels significantly fell ($P<0.01$). Additionally, HbA1c levels significantly increased ($P<0.05$), indicating that the extract can be useful in treating diabetes and associated lipid issues.[25]

6.4 Panax ginseng

Herbal medicine has traditionally made use of Panax ginseng. Panax ginseng fruit extract was tested for its ability to prevent diabetes in mice with diabetes caused by streptozotocin. The extract has demonstrated promising results in stimulating increased insulin production in animals with beta-cell deficiencies, indicating beta-cell regeneration and improved glycemic control. The mechanisms behind these effects were also investigated. [26]

6.5 Cassia javanica

Kumavat et al. examined the hypoglycemic potential of the beautiful and little-known plant Cassia javanica in streptozotocin-induced diabetic rats. First, the acute oral toxicity of the medication was investigated. The phytochemistry of the medication was then examined using standard qualitative techniques to identify its antidiabetic ingredients. Rats that were given single and numerous doses of the drug were used to test blood glucose, serum proteins, serum cholesterol, and serum triglycerides. The test drug's acute and subacute treatments markedly changed the abnormal levels of serum metabolites in diabetic rats as compared to the usual medication. [27]

6.6 Ocimum Gratissimum

Albino Wistar rats with diabetes caused by streptozotocin were administered an aqueous leaf extract of Ocimum gratissimum (OG) orally. Changes in the rats' weight, food intake, and water intake were noted. The extract was given to the diabetic-treated (DMT) groups daily for 28 days at a dosage of 1500 mg/k body weight. The results showed that Ocimum gratissimum reduced blood sugar levels in diabetic rats and treated the main symptoms of diabetes mellitus, such as weight loss, increased hunger, and excessive thirst.[28]

6.7 Thymeleae hirsute L.

Researchers investigated the potential benefits of a polyphenol-rich fraction of Thymeleae hirsuta L for rats with streptozotocin-induced type-2 diabetes and NO-deficient hypertension. The findings indicated that the Thymelaea hirsute fraction high in polyphenols decreased blood pressure and hyperglycemia, perhaps as a result of its polyphenol concentration. As a dietary supplement, it was suggested that this extract could help prevent type-2 diabetes and hypertension. [29]

6.8 Murraya koenigii and Ocimum tenuflorum

The antidiabetic potential of Ocimum tenuflorum L. and Murraya koenigii (L.) Spr. was assessed in Swiss mice with streptozotocin-induced diabetes. Adjuvant therapy with the chloroform extract of M. koenigii (MKC) and the aqueous extract of O. tenuflorum (OTA) as additives resulted in improved glucose consumption, increased activity of the liver glucose-6-phosphate dehydrogenase enzyme, normal glycogenesis in hepatic and muscle tissues, inhibition of intestinal and pancreatic glucosidase, decreased postprandial hyperglycemia, increased glucose metabolism, prolonged glucosidase inhibition, improved

endogenous insulin secretion, protection of pancreatic β-cells, and functional pancreatic islets.[30]

6.9 Aegle marmelos (L.)

Aegle marmelos (L.) Corr. (Rutaceae) bark extract was tested for its antidiabetic properties in rats with streptozotocin-induced diabetes during a 30-day period. The biochemical indicators evaluated for the methanolic extract included blood glucose, total protein, hepatic glycogen, glycated hemoglobin (HbA1c), marker enzymes of hepatic function, carbohydrate metabolism, and plasma insulin. Phytochemical investigations indicate that lupeol (0.29% w/w) and aegelin (1.27% w/w) are potent antihyperglycemic agents. Histological analysis demonstrated the extract's substantial antidiabetic potential by revealing its regeneration effects on β-cells. [31]

6.10 Adenanthera pavonina

The effects of Adenanthera pavonina L. seeds aqueous extract (APSAE) on diabetic neuropathy in rats with streptozotocin-induced diabetes were evaluated over 0, 4, 8, and 12 weeks. Numerous metabolic parameters were evaluated in a dose-dependent manner, together with measurements of temperature, colder, spontaneous motor activity, and changes in motor coordination. The histology of the sciatic nerve was also examined to assess nerve stability. The results demonstrated that the extract exhibits neuroprotective properties when compared to pregabalin. [32]

6.11 Caesalpinia bonduc

Caesalpinia bonduc hydro-methanolic extract was tested for several diabetes issues in diabetic rat models. 250 mg/kg of the extract was taken orally for 21 days. Glycogen levels, blood glucose, lipid peroxidation levels, antioxidant enzymes such as catalase and superoxide dismutase, and enzyme markers used for toxicity evaluation all showed notable improvements following therapy. This demonstrated C. bonduc's benefits as a potent antioxidant and antihyperglycemic agent. [33].

6.12 Juglans regia

The antihyperglycemic properties of Juglans regia leaf extract were examined by Mohammadi et al. in diabetic rats induced by streptozotocin nicotinamide. For four weeks after the diabetes was induced, metformin and juglans regia extract were continuously administered orally. Analysis of fasting blood sugar, body weight, serum lipids, and insulin level in the corresponding groups revealed that after 4 weeks, rats treated with Juglans regia extract had significantly lower levels of glucose, HbA1c, total cholesterol, and serum triglycerides than the control groups. According to this, Juglans regia is a potent antidiabetic. [34]

6.13 Euphorbia hirta

The therapeutic advantages of the ethanolic extract of Euphorbia hirta were evaluated in streptozotocin-induced diabetic rats, with glibenclamide serving as the reference. The extract was administered orally at doses of 400 mg/kg, and its effects were assessed at 0, 7, 14, and 21-day intervals. A significant drop in blood glucose on the seventh day after continuous administration, along with an improvement in the lipid profile—which comprises triglycerides, cholesterol, low-density lipoprotein, very low-density lipoprotein, and high-density lipoprotein—showed its antihyperlipidemic and hypoglycemic potential. [35]

6.14 Talinum Triangulare

Rats that were streptozotocin-induced experimental animals, rats that were glucose-loaded, and healthy rats were used to test the antihyperglycemic effects of Talinum triangulare. When administered at a dosage of 250 mg/kg for two weeks, the extract significantly reduced blood glucose levels in both diabetic and normal glucose-loaded rats. Significant hypoglycemia was evident in the rats during the oral glucose tolerance test. The combination of glipizide and the extract had a significant synergistic effect. [36]

6.15 Symplocos cochinchinesis

The therapeutic effects of S. cochinchinensis bark methanolic extract (SCBe) were examined in diabetic rats using glibenclamide as the reference. At 250 mg/kg and 500 mg/kg for 28 days, respectively, the extract enhanced lipid indicators, liver glycogen, altered plasma enzymes, total protein, urea, creatinine, plasma insulin, and blood glucose. The results and in vitro studies proved the antioxidant, antidiabetic, and antilipidemic qualities of SCBe. [37]

6.16 Otostegia persica

Aqueous extract of Otostegia persica was tested in male Wistar rats (150–200g) with streptozotocin-induced diabetes. Compared to the diabetic control group, the extract showed significant hypoglycemic activity at different doses, especially at 400 mg/kg. Histology revealed that serum triglycerides and homeostasis had improved, especially in the T400 group of mice, whereas pancreatic β-cell mass and quantity had decreased.[38]

7. Therapeutic Potential :

7.1. Action Hepatoprotective

The leaves of C. fistula showed significant hepatoprotective advantages by reducing the blood levels of bilirubin, transaminase, and basic phosphatase, just as a normal hepatoprotective medication. [39, 40]

7.2. Properties That Prevent Heat

Significant antipyretic action was exhibited by the pod of C. fistula, which reduced fever caused by yeast.[41]

7.3. Action Against Cancer

The methanolic extract of C. fistula was shown to have a cough-suppressive effect similar to that of codeine phosphate, reducing cough by up to 51.85% in comparison to the standard. [42, 43, 44] 6.4. Antioxidant Activity In both the methanolic (20%) and ethanolic (20%) extracts, the stem bark and leaves of C. fistula demonstrated potent antioxidant activity and served as free radical scavengers. [45,46]

7.5. Inflammation-Reduction Activities

Methanolic and aqueous extracts of C. fistula bark showed powerful anti-inflammatory potential in both acute and chronic conditions, exhibiting dose-dependent protective effects against lipid peroxidation and the liver's generation of free radicals. [47, 48, 49]

7.6. Antimicrobial/Healing Impact

The ethanolic extract of C. fistula leaves shown antibacterial activity against a range of pathogenic microorganisms and enhanced the rates of wound healing and tissue regeneration in rats. [50, 51, 52]

7.7. Possible Effects on Cancer

The methanolic extract of C. fistula had a substantial effect on the growth of Ehrlich ascites carcinoma and the life duration of tumors in mice, resulting in a decrease in tumor volume and an increase in longevity. [53, 54]

7.8. Diabetes Prevention Activities

The seeds of C. fistula showed a hypoglycemic activity, dramatically lowering blood glucose levels in both diabetic and healthy albino mice.[55]

7.9. Central Nervous System Activity

The methanolic extract of C. fistula seed had a substantial influence on mice's behavior by intensifying the sedative effects of diazepam, chlorpromazine, and sodium pentobarbitone.[56,57]

7.10. Itching Prevention Activities

In addition to being effective against eczema and skin irritation, C. fistula was shown to alleviate the common chronic skin illness vicharchika. [58,59]

7.11. Possible Anti-Cancerous

The ethanolic leaf extract of C. fistula has been proposed to have anti-ulcer effects. [60,61]

7.12 Inhibition of Infertility

In fertile albino female rats, the anti-fertility effect of the ether extract of C. fistula seed was evaluated at daily doses of 500, 200, and 100 mg/kg body weight. Following oral treatment of the mated female rats, there was a substantial decrease in the

number of uterine implants, fertility index, and viable babies on the fifteenth day of pregnancy. [62,63,64]

7.13. Purgative/Laxative Action

Because of its waxy aloin concentration, C. fistula is well-known for its laxative qualities. Compared to senna, it is said to be a safer and more potent purgative. [65,66]

7.14. Possible Epilepsy Prevention

The anti-epileptic effects of C. fistula have been proven. Extracts from C. fistula seeds significantly reduced the length of clonic convulsions in mice and delayed the onset of pentylenetetrazol-induced convulsions. [67, 68, 69]

CONCLUSION:

Among the various pharmacological properties that make C. fistula a popular option are hepatoprotective, anti-ulcer, wound healing, anti-pyretic, anti-tussive, anti-inflammatory, anti-oxidant, anti-cancer, anti-fungal, anti-microbial, anti-itching, anti-epileptic, and anti-fertility effects. Its leaves and bark are used to treat skin diseases, while its roots are used as a diuretic and to treat ulcers, heart issues, and tubercular glands. For many gastrointestinal issues, fruit pulp can be used as a moderate laxative. The flowers are used to cure leprosy, fever, and stomach problems. The seeds contain laxative, cooling, and antipyretic properties. This plant is rich in tannins, glycosides, flavonoids, linoleic, oleic, stearic, and carbohydrate components. It also includes arginine, protein, leucine, ox anthraquinone derivatives, flavonid-3-ol-subordinates, lepeol, hexacosanol, tannins, free rhein, sennosides A and B, isoflavoneoxalic acids, astringent materials, and B-sitosterol. Glycosides, vernolic oil, aurantimide, bianthroquonones, fistulic acids, glutten matter, kaempferol, malvalic acid, sterculic acid, and anthraquinones are examples of basic oils.

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HOW TO CITE: Rahul shinge*, viraj Mahajan, Dr. N.B. Chougule, A Review Of Therapeutical Potential Of Cassia Fistula In Diabetic Mellitus, Int. J. of Pharm. Sci., 2024, Vol 2, Issue 11, 446-458. https://doi.org/10.5281/zenodo.14056088