

A SCIENTIFIC UPDATE ON *PASSIFLORA*

FOETIDA

ABSTRACT

Introduction: This review describes the importance of medicinal plant *Passiflora foetida* in the modern world. The unique compounds produced from plants extract have a tremendous impact of pharmacological medicine to community health. Among 190 countries, approximately 85% have dependency of traditional systems of Ayurveda, Homeopathy and Unani that have contributed for exploring remedial plants. *Passiflora* is a prominent medicinal plant with major photo-constituents such as flavonoids, glycosides, alkaloids, phenolic and volatile constituents those are potent for potential therapeutic practice. .

Aim: This article focus, specifically on *Passiflora foetida* internationally recognized as red fruit passion flower describing a distribution across the globe, taxonomic, information of significant database of *P. foetida*, morphology, traditional, remedial uses, phyto-constituents, pharmacological reports and clinical applications.

Study design: Comprehensive Literature survey including National and International Journals for assembly of pharmacological aspect of medicinal *P. foetida*.

Results: The extracts of this plant have potential tendency against several treatments for anxiety, insomnia, convulsion, sexual dysfunction, cough, inflammation and cancer. *P. foetida* is rich in fiber content, used in paper production industries. Every single part of *P. foetida* such as leaf, root, stem and fruit has tremendous medicinal properties, making plant hot spot for new drug discovery in pharmaceutical industry. In various, countries *Passiflora* fruits are farmed for making cold drink; ice cream flavor thus *P. foetida* farming could be the best source for economic earning.

Conclusion: This review form information package specifically of pharmacological importance of *P. foetida* that will assist researcher for identification of viable bioactive compounds. *P. foetida*, distribution around the globe, medicinal uses, habitat, morphology, phytochemical are discussed that would be useful in research design. This plant carries large numbers of bioactive phytoconstituents that may be effectively raised for drug in pharmaceutical industry.

Keywords: *Passiflora foetida*, Secondary metabolites. Phytochemicals, Phenylpropanoid pathway.

1. INTRODUCTION

Earth is a best source for numerous medicinal plants. It has a power to revolutionize a genetic trait with high nutritional and curative properties by natural selection. Since long history humans have an advantage of exploring medicinal plants for curing varied illness. The global market for medicinal plants and herbal medicines is estimated to be worth of US\$ 80 billion per year. International export trade in medicinal plants from India is 32600 tons per

year [43]. According to World Health Organization [57], Medicinal plants have neutral side effects, greater specificity, efficacy [32] thus, worlds 70 percentages of countries depend on a traditional health care system for treatment of several illnesses [26].

India has a long past for using remedial plants for health care system. Medicinal plant parts such as leaf, stem, root and flowers are used for preparation of extracts for identification of compound with potent medicinal properties. About 85 percentages of traditional medicines in India are prepared from plant extracts. Present age is of contemporary technology where human have advanced extremely to new level of fresh age, in which there are indiscriminate deforestation, industrialization, urbanization, and uncontrolled population that have resulted in disappearing of numerous medicinal plants in alarming rate. It is crucial to note that medicinal plants have the tendency to cure many diseases with minimum side effects and are constant hot spot sources for exploration from their natural habitat. Thus, many scientific researchers have tested, isolated and identified components with specific activity from the mixture of compounds in medicinal plants. These active components are further processed and used as drug in pharmaceutical industries. As the drugs are produced from the natural and freely available plant sources several developing countries such as Bangladesh (90%), Myanmar (85%), India (80%), Nepal (75%), Sri Lanka (65%) and Indonesia (60%) and few other south East Asian countries have deliberately focused research on medicinal plants [4]. It is carved in history that the medicinal plants are the best source for treatment of varied minor to harsh human diseases such as cough, temperature, skin burns, fungal infection, inflammation, Diabetes mellitus and rheumatoid arthritis [13].

2. *Passiflora foetida* information

Passiflora foetida Linnaeus, 1753 annual vine climber grows 1-6 m tall with eye catcher beautiful flower, that has been previously in 15th century noted for the Passion of Christ, and named as passionflower (28). This plant has woody roots, solid stem, tendrils, and leaves carry distinctive hairs all over plants that secrete an odorous chemical and thus specific named stinking passion flower. There are about 600 species of this plant reported in several places in Asia. Including India, Thailand, Myanmar, Indonesia, Singapore and many more that are occurred in tropical and sub tropical part of the world [48].

Taxonomic Tree

Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Class: Dicotyledone
Order: Violales
Family: Passifloraceae
Genus: *Passiflora*
Species: *Passiflora foetida* [6].

3. Data base content Useful data base for *P. foetida* information.

1. <http://www.threewa.co.uk/passion/>
2. <http://www.media-public.de/passiflora>
3. www.biosecurity.qld.gov.au [50]

4. <http://www.passionflow.co.uk/>
5. <http://www.passiflorasociety.org/>
6. <http://passiflora.org/>
7. <http://www.discoverlife.org>
8. <http://www.marinespecies.org>
9. <http://www.nlm.nih.gov>

4. Traditional uses

This plant is used for traditional purposes and there are numerous **Pharmacological** products prepared from *Passiflora foetida* that are accepted in India, America, France, Brazil, Vietnam and European nations. In India, this plant is used for forming lotions for skin disease & for preparation of medicinal powder for digestive problems. In Brazil, this plant is used to formulate lotions for skin diseases with inflammation. In Vietnam, leaves are used for tea making for vanishing sleeping and nervous disorders.

5. Medicinal uses

Passiflora foetida is well known for its used in medicinal purpose it is used as surface covering for smothering weed and to enhance organic matter production. The leaves are employed in baths for skin affections [1]. Raw fruits are directly eaten in Thailand [39] Fruits are used for preparation of refreshment in Venezuela [40]. Common disease in chickens such as Newcastle disease is treated with different preparations of the fruits, leaves, stem and seeds [14]. **Passiflora foetida** organ's parts have various medicinal values for treating chronic pain, cough, asthma, insomnia, hysteria, emmenagogue, biliousness, digestive problems, including dyspepsia [12] and expectorant for nervous conditions, spasms and [41] anti inflammatory activity was observed in mice study [22]. A research by [44] suggests that *P. foetida* extracts possess antidepressant effects that could be used in the treatment of patients with depressive disorders. Leaf extracts of **P. foetida** show antibacterial properties of against four human pathogenic bacteria, i.e. *Pseudomonas putida*, *Vibrio cholerae*, *Shigella flexneri* and *Streptococcus pyogenes* [30]. Leaf extracted in methanol shows antifungal and antibacterial activity with presence of cyclopropane, triterpine and glycoside compounds [53]. Vitexin could be anti-inflammatory and Kaempferol, apigenin and luteolin may lead to anti-allergic drug development for compensation of excessive steroidal drugs usage has been observed by [7].

6. *Passiflora foetida* in India

In India **P. foetida** grown as runner plant occurred mostly in wet places associated in spiky trees and grows over the surface of land if support is unavailable. It is normally seen as a decorative plant because of its flower. Life stages of *P. foetida* are represented in figure **no1.**

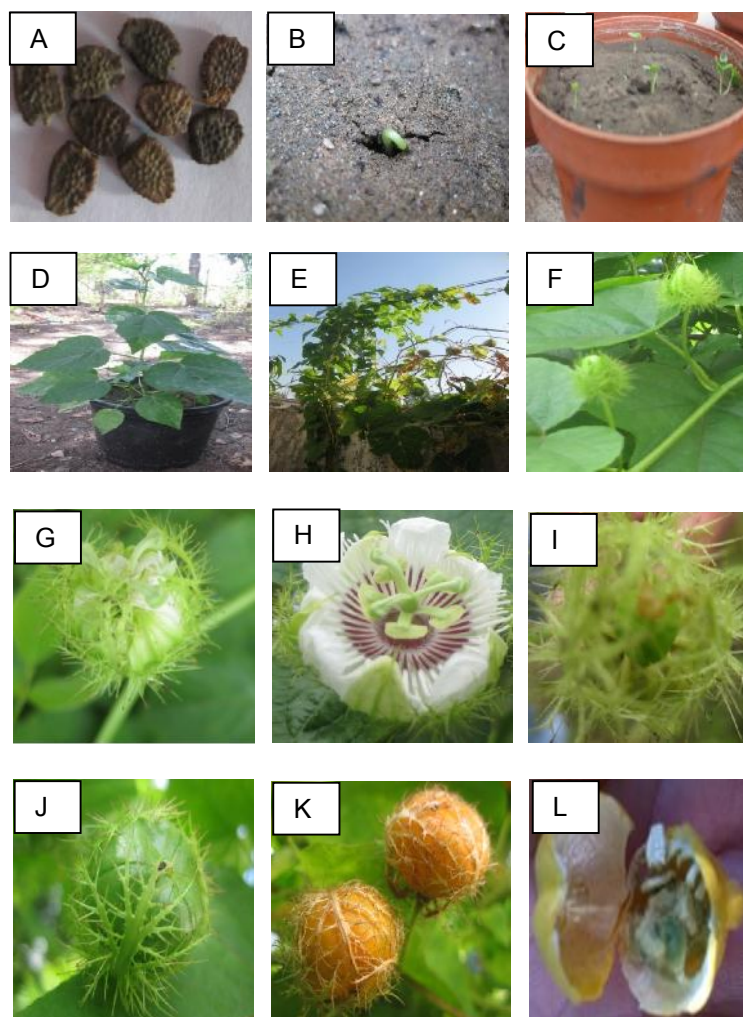


Figure 1 The photo shows pictures of various life stages of *Passiflora foetida*.

A: Seeds, B: Germinating seed, C: Partial developed plant, D: Maturing plant, E: Matured plant. F: Flower bud. G: opening of a flower. H: Mature flowers. I: Closing of a flower. & fruit formation of a closed flowers. J: developing fruit. K: Fully developed fruit. L: Seed bursting.

7. *Passiflora foetida* in foreign countries

In several nations, *P. foetida* grows as annual climbing herb produced from seed that may be survived, germinated in warm and moist soil. This plant is seen in moist lands, marshy, neglected places, riverbanks and lake side. *P. foetida* favors are grown on soaked areas, dry conditions and tolerate in arid conditions [39]. In Guam, wild *Passiflora* was seen in both volcanic and limestone soils and is grown in waste land [31]. *P. foetida* usually grows along spiky tree that serves as support for growth of the plant. However, if this support is unviable, then *P. foetida* grows in a form of mat over surface area. In Hawaiai, *P. foetida* are observed

in large groups growing over a long lava flow, road sides. *P. foetida* forms an impact on other plants by growing as mat covering in the absence of support and inhibiting other plants from growing. It is a common weed in several countries, including Australia, Bolivia and Argentina [41].

8. Native distribution

Natural community of this plant was observed in river, lakes, costal mountain ranged in Central America, Africa, South East Asia, Pacific region and in state of Parana, Brazil South America [24].

9. Modern distribution

This plant is widely distributed in South America, American Samoa, Cocos Islands, Commonwealth of the Northern Mariana Islands, Cook Islands, Federated States of Micronesia, Fiji, French, Galapagos Islands, Guam, Hawaiai, Kiribati, Marshall Islands, New Caledonia, Solomon Islands, Tonga, Vanuatu, Wake Island, Wallis and Futuna Islands, Poland, Finland, European countries, Japan, Malaysia, Thailand, Kenya, Nigeria, south Africa, Singapore, China, Hong Kong, India, including Assam, Amravati, Nagpur and Tamil Nadu. Table no1 clearly represent the language and common name for *Passiflora foetida* in India and Table no 2 indicates *P. foetida* distribution around the world with their origin and called name.

Table no1 represent the language and common name for *Passiflora foetida* in India.

Sr no	Language	Country	Commonly known	References
1	English	India	love in a mist, Stinking passion flower, Smelling flower	(58)
2	Hindi	India	Rakhi flower, krishnna kamal, Jhumka lata,	*
3	Bengali	India	Jhumka lota	*
4	Manipuri	India	Lam Radhikanachom	*
5	Marathi	India	Vel ghani	*
6	Kannada	India	Kukkibali	(58)
7	Malayalam	India	Chirrachantiya, Poochapalam	(58)
8	Tamil	India	Siruppunaikkali, Chiru punai k kali, Mupparisavalli	(58)
9	Telugu	India	Tellajumiki	(58)

199 **Note:** * Local sources

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201

202 **Table 2** Presentation of origin, occurrence, common name, invasive and country for
203 *Passiflora foetida*.

Sr no	Country	Origin	Commonly known	Invasive	References
ASIA					
1	Cambodia	-	-	-	(20)
2	China	-	long zhu guo	-	(20, 21, 33)
3	Hong Kong	-	-	-	(21)
4	Christmas Island (Indian ocean)	-	-	-	-
5	India	Native	banchathail, mukkoopera, Krishna kamal, rakhi flower.	Non invasive	(20, 21, 34)
6	Maharashtra	-	Krishna kamal, rakhi flower.	-	(27)
7	Japan	-	kusa-tokeiso	-	(20)
8	Lebanon	-	-	-	(20)
9	Malaysia	-	pokok lang bulu, timun dendang	-	(20, 55)
10	Sarawak	Native	-	-	(54)
11	Myanmar	-	-	-	(55)
12	Philippines		kurunggut, lupok-lupok, masafloa, melon meleanon, pasionariang-mabaho, prutas taungan	-	(21,35, 55)
14	Singapore	-	timun dendang, timun hutan, timun pandang	-	(3, 55, 58)
15	Sri Lanka	-	wal wel dodam or padawal , dalbattu, kodimathulai, madahalu, udahalu	-	(10, 20, 21, 46)
AFRICA					
16	Congo	-	-	-	(20, 21, 49)
17	Ghana	-	-	-	(21)
18	Kenya	-	-	-	(20)
19	Madagascar	-	Tsipopoka	-	(20)
20	Nigeria	-	-	-	(21)
21	South Africa	-	running pop	-	(56)
North America					
22	Mexico	Native	clavellín blanco, granadilla, jujito peludo, jujo	Non invasive	(20, 24)
23	USA	-	-	-	(21)

24	Arizonan	Native	-	Not invasive	(24)
25	Hawaii	-	scarlet fruited passion flower	-	(17,20, 21,)
CENTRAL AMERICA AND CARIBBEAN					
26	Bahamas	Native	-	Not invasive	(24)
27	Barbados	Native	-	Not invasive	(24)
28	Belize	Native	-	Not invasive	(24)
29	British virgin island	Native	-	Not invasive	(24)
30	Costa Rica	Native	-	Not invasive	(24)
31	Cuba	Native	-	Not invasive	(20, 24)
32	Curacao	Native	-	Not invasive	(24)
33	Dominica	Native	-	Not invasive	(24)
34	Dominican Republic	Native	caguazo, mariballa	Not invasive	(20, 21,24)
35	Elsalvador	Native	-	Not invasive	(18, 21, 24)
36	Guadeloupe	Native	-	Not invasive	(24)
37	Guatemala	Native		Not invasive	(24)
38	Haiti	Native	-	Not invasive	(24)
39	Honduras	Native	-	Not invasive	(20, 21,24)
40	Jamaica	Native	granadilla, love in a mist, sweet cup	Not invasive	(20, 21,24)
41	Martinique	Native	-	Not invasive	(24)
42	Montserrat	Native	-	Not invasive	(24)
43	Nicaragua	Native	-	Not invasive	(20, 21,24)
44	Panama	Native	-	Not invasive	(20, 21, 24)
45	Puerto Rico	Native	flor de pasion sylvestre, silvestre, tagua tagua	Not invasive	(20, 21,24)
46	Saint Kitts and Nevis	Native	-	Not invasive	(24)
47	Saint Vincent and the Genadines	Native	-	Not invasive	(24)
48	Trinidad and	Native	-	Not	(21, 24)

	Tabaço			invasive	
SOUTH AMERICA					
49	Argentina	Native	ataco, corona de Cristo, granadilla,	Not invasive	(11, 24)
50	Bolivia	Native	Pendon	Not invasive	(15, 24)
51	Brazil	Native	maracajusinho (San Luis Island), maracujá catinga, maracujá de cheiro, maracujá de cobra, maracujá de estalo, maracujá de lagartinho, maracujá fedorento, maracuja-da-petra	Not invasive	(9, 20, 24)
52	Chile	Native	-	Not invasive	(11, 24)
53	Colombia	Native	bejuco canastilla, chulupa de loma, cinco llagas, cocorilla, curubo, flor de la pasión, gulupo	Not invasive	(20, 21, 24)
54	Ecuador	Native	Love in a mist	Not invasive	(24)
55	Galapaqos island	Native	-	Not invasive	(2, 24)
56	French Guiana	Native	passiflore fétide	Not invasive	(24, 46)
57	Guyana	Native	-	Not invasive	(24)
58	Paraguay	Native	-	Not invasive	(24)
59	Peru	Native	bolsa mullaca, granadilla, granadilla cimarrona, puru-puru	Not invasive	(20, 21, 24)
60	Suriname	Native	-	Not invasive	(21, 24)
61	Uruquay	Native	-	Not invasive	(11)
62	Venezuela	Native	cojón de gato, parchita de culebra, parchita de Montana	Not invasive	(18, 20, 24)
OCEANIA					
63	American Samoa	-	pasio vao	-	(55)
64	Australia	-	mossy passion flower	-	(20, 36)
65	Australian northern tertiary	-	-	-	(19, 20)
66	New South Wales	-	-	-	(19, 20, 36)
67	Queensland	Introdu	-	-	(19, 20, 36)

		ced			
68	South Australia		-	-	(20, 36)
69	Western Australia	-	-	-	20
70	Cooks island	-	-	-	(55)
71	Fiji	-	Wild Passion Fruit	-	(20, 21,37)
72	Tonqan	-	vaine 'ae kumā, vaine 'initia	-	(33)
73	Vanuatu	-	-	-	20
74	Wallis and Futuna islant	-	-	-	20
Note: This table is prepared from the information given on web site (CABI, 2013) and assembled from website (CAB International: www.cabi.org/isc) on dated 2 January 2014.					

204

205 10. Habitat

206 This plant found usually in association with spike plants or shrubs and grows on, moist
 207 marshy places, dry, arid, river side, lake side and few reports for long side of lava. It is a
 208 weed plant in many places of Pacific, and Atlantic were it found along road side vegetation.
 209 However, it is grown for a decorative and gardening purpose in India and Poland.

210 11. Propagation and seed Germination

211 *Passiflora foetida* is propagated from seed and by planting branch of stem in soil. Seed
 212 sowed germinates within two weeks after sowing.

213 12. Morphology

214 Love-in-a-mist is a perennial vine climber, sometime surface coverer, which has a trifoliate
 215 leaf, an edible fruit and has beautiful eye catching flower.

216 • **Seed** Riped seeds are blackish to brown in color, flattened and wedge in shape of 3-
 217 4mm in size.

218 • **Leaves** Leaves are three lobed with spiked viscid hairy leaves 3-parted; segments-
 219 apices acute; leaf based cordate; both sides hispid-hirsute; blades 3, 5-10cm long,
 220 4-12cm wide; petiole 2-6cm long; with prominent veins,

221 • **Steam** The stems are 1-6m long, branched, thin, wiry and woody, covered with sticky
 222 yellow hairs with tendrils.

223 • **Tendrill** Tendrils are spring like coiled in nature and grasped support present around
 224 and helps the plant to grow faster.

225 • **The flower** The flowers are erected at axis white color outer side and dark pink to
 226 violet to inner circular side with figure like projection outward from flower. A flower is
 227 about 5-6 cm in diameter with 13-15 petals and 8-11 sepals. The stamens arising
 228 from top middle of flower with three styles. Peduncle 3-5 cm long, a bract 2-4 cm
 229 long.

230 • **Fruit formation** The fruit is small about 2-3 cm diameter, green at initial fruiting,
 231 yellowish on maturing and orange to red when ripped. Fruit is enclosed with
 232 numerous 250-300 black seeds embedded in the pulp; the fruits are eaten and the
 233 seeds dispersed by birds. The bracts of this plant serve as a defensive mechanism
 234 to protect its flowers and fruit. Some paper presents that bract of plant digests and
 235 gain's nourishment from the trapped. This is still an issue of debate and research
 236 among carnivorous plant enthusiasts [33]. The fruit is edible. However, it is not a
 237 common food item. "It has a sweet taste, similar to the large fruited *Passiflora* that
 238 are popular in areas of the Pacific and Atlantic" [31].

239 • **Seedling** germinates from soil with hypocotyl 4-12 mm long green in color, two
 240 juvenile leaves ovate in shape. The temperature range 19-29°C is good for
 241 seedlings [52].

242 • **Special features**

243 **A) The bract** of this plant trap insect and exude a digestive enzyme. The larvae heliconii
 244 butterflies of family nymphalidae grow on this plant.

245 **B) Unique flower opening and closing** *P. foetida* produces flowers in the month of
 246 September December in India. It has a unique opening pattern it is usually open in morning
 247 5 am and closed around 11 am on a same day, same is followed for next three days. Later
 248 Flowers closed to form fruit. *P. foetida* produces flowers and fruits between October and
 249 February in Brazil [9] and throughout the year, mainly from September to May in Argentina
 250 [11].

251 **13. Phytochemicals of *P. foetida***

252 The important phytochemicals of this plant are alkaloids, phenols, glycoside, flavonoids,
 253 cyanogenic compounds [13] [30]. Other constituents are C-glycosyl flavonoids such as
 254 chrysoeriol, apigenin, luteolin, kaempferol, isoschaftoside, 2"-xylosylvitexin, isovitexin and
 255 vitexin [51]. Vitexin exhibited anti-inflammatory and anti-spasmodic properties. Cyanohydrin
 256 glycoside tetraphyllin A, tetraphyllin B, tetraphyllin B sulphate, deidaclin, volkenin, fatty acids,
 257 linoleic acid, alpha-pyrone named passifloricin are some of the other phytoconstituent
 258 reported in *P. foetida* [12]. In recent vitexin and isovitexin show inhibition of formation of
 259 advanced glycation end products (AGEs) that are found to be implicated in diabetic
 260 complications [39].

261 **14. Biosynthesis of Phytoconstituents of *P. foetida* through Phenylpropanoid pathway**

262 Plant usually produced secondary metabolites to overcome biotic and abiotic stress [8] by
 263 activating phenylpropanoid pathway producing diverse metabolites such as lignin, alkaloids,
 264 flavonoid, iso flavonoid, phlobaphene [25]. First most enzyme phenylalanine ammonia-lyase
 265 (PAL) greatly increased its activity after wounding was observed by [23]. Phenylalanine
 266 ammonia-lyase is converted to cinnamic acid further through subsequent oxygenases,
 267 transferases and reductase reaction p- Coumaryl CoA is generated [53], which is a
 268 precursor for other secondary metabolites produced through diverse pathway route. The
 269 figure no 2 shows a complete pathway for production of secondary metabolites. In recent,
 270 some other aromatic metabolites like coumarin, phenolic volatiles and ester-related
 271 compounds are also found to be produced against a stress response. There are some
 272 unique antimicrobial and microbial compounds that are produced on wound stress [43].

273

274

275 **Figure2:** Phenylpropanoid metabolic pathway this pathway has been crafted using
276 information available from [23] [24].

277

278 **Phenylpropanoid Metabolic Pathway [23] [24]**

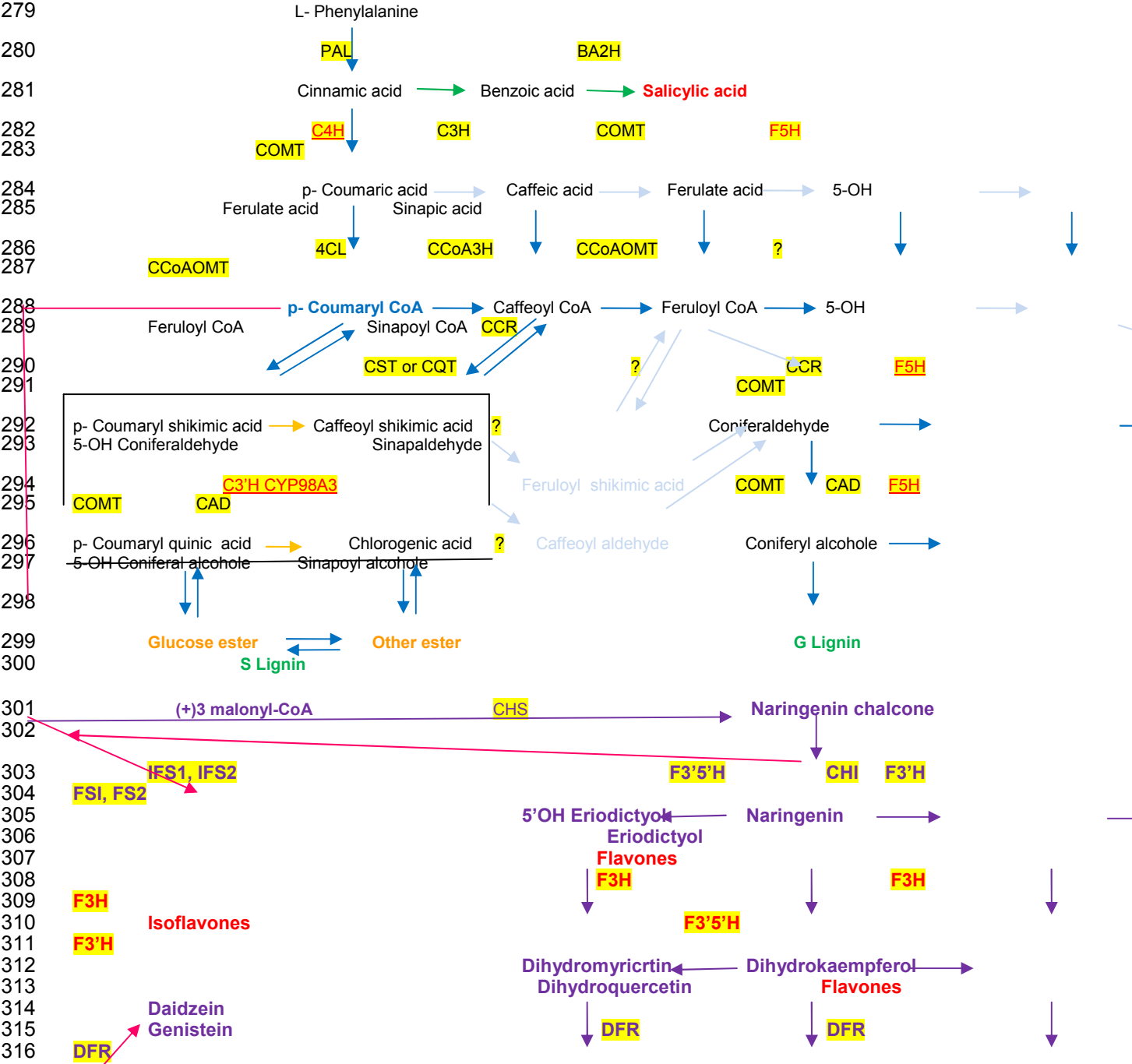


Figure2: Phenylpropanoid metabolic pathway: this pathway has been grafted using information available from paper cited above. Enzyme are denoted in uppercase, following are enzyme listed below, Phenylalanine ammonia lyase (PAL), Cinnamic acid 4-hydroxylase(C4H) 4-coumarate:CoA ligase (4CL), Hydroxycinnamoyltransferases (HCT) [30], p-Coumarate 3- hydroxylase (C3H), Caffeoyl CoA O-methyltransferase (CCoAOMT), Cinnamoyl CoA reductase (CCR), Ferulate 5-Hydroxylase (F5H) (Aguade., 2001), Caffeic acid O-methyltransferase (COMT), Cinnamyl alcohol dehydrogenase (CAD). (CHS) Chalcone synthase: (CHI), Chalcone isomerase: (IFS), Isoflavone synthase: (F3'H), flavonoids 3' hydroxylase (F3',F5'), flavonoid ' , 5' hydroxylase: (DFR), dihydroflavonol-4- reductase: (ANS), anthocyanidin synthase: (UFGT), UDP- flavonoid glucosyl transferase: (BA2H), benzoic acid 2- hydroxylase [23] [24] and metabolites are Tannins, Proanthocyanidins, Anthocyanins, Isoflavanones, Phytoalexines, Isoflavones, Glucose ester, other ester , G Lignin, S Lignin, Salicylic acid, p- Coumaric acid , Caffeic acid, Ferulate acid, 5-OH Ferulate acid and Sinapic acid.

353 **15. Economic importance**

The studies performed by [5] suggest that *P. foetida* is rich in fiber content, about 17.7% and shall be economic for various paper production industries. It has been reported that all parts of *P. foetida* such as leaf, root, stem fruit has tremendous medicinal properties, making plant hot spot for new drug discovery in pharmaceutical industry. In various, countries

passiflora fruits are farmed for making cold drink; ice cream flavor thus *P. foetida* farming could be the best source for economic earning.

16. Future Prospects

P. foetida traditional and medicinal uses would be crucial for treatments of several diseases. The complete understanding of phyto constituents of *P. foetida* would be beneficial for designing a drug with better efficiency and efficacy. This paper would help researchers for understanding physiology and various secondary compounds that are produced upon abiotic or biotic stimuli. Phenylpropainoid pathway understanding would clear the puzzle of biosynthesis of those compounds. This will help in studies of phenylpropanoid pathways in related and distance species, for production of novel compounds. The well-known research on *P. foetida* is not up to the mark; very few works have been done in India. Some paper indicated *P. foetida* for sedative, hypnotic, sleep aids and herbal products with solid support for clinical cases.

17. CONCLUSION

Medicinal Plants has significantly provided the discovery of novel drugs that are safe with improved efficiency and efficacy. In this review, a complete information package is provided specifically of *P. foetida* that would be helpful for sketching of research work and identification of viable bioactive compounds. *P. foetida*, distribution around the globe, medicinal uses, habitat, morphology, phytochemical are discussed that would be useful in research design. This plant carries large numbers of bioactive phytoconstituents that may be effectively raised for drug in pharmaceutical industry. This paper would boost in research information with working on *P. foetida*.

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