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# An overview of Selected Economically Important Genera of Family Caesalpinioideae

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**Abstract:** In this chapter, economically important plant species belonging to the Caesalpinioideae family are discussed. The plant family Caesalpinioideae is a subfamily belonging to Leguminosae. The plant species of Caesalpinioideae are trees or shrubs with alternate, compound leaves. They are provided with extra-floral nectaries or glands on the rachis. The diagnostic feature of the family is the posterior petal being overlapped by the lateral petals. Since the family is of great importance, this chapter provides detailed information on the uses, folk medicine, chemistry, distribution, cultivation, harvesting, yields and economics of selected economically important genera of the family.

**Keywords:** Caesalpinioideae, economic importance, cultivation, harvesting, uses.

## 1. INTRODUCTION

The family Caesalpinioideae is a heterogeneous group of plants with about 160 genera and some 2,000 species distributed throughout the world. Species of the family are primarily woody plants in the tropics while in temperate regions they are mostly herbaceous (nonwoody). Members of the Caesalpinioideae can be identified by their alternate, stipulate, compound pinnate leaves without stipels. The conduplicate leaflets may be alternate or paired and with a paripinnate or imparipinnate (an odd terminal leaflet) arrangement. The leaves are provided with a pulvinus at the base of the petiole and a pulvinule at the base of the petiolule. Compound racemose inflorescences of zygomorphic five-part flowers each with a single superior carpel are usual. The fruit is generally a pod. The plant species belonging to Caesalpinioideae have great importance in many dimensions. The diversified habit and habitat of Caesalpinioideae species form the basis of economic importance. Many species of the family are cultivated for their variety of uses and medicines. This review aims to provide detailed information on some selected economically important genera of the family Caesalpinioideae. *Bauhinia esculenta* Burchell: Common Name: Camel's foot Uses: Pods are an important food for natives of South Africa. Seeds are sometimes used like peas or garbanzos. Folk Medicine: Said to be astringent. Chemistry: Raw leaves are reported to contain per 100 g, 82 calories, 73.3% moisture, 19.9 g carbohydrate, 6.8 g fiber, 0.1 g fat, 4.3 g protein, 2.4 g ash, 86 mg P, 436 mg Ca, and 68 mg ascorbic acid. Baked or dried seeds contain 554 calories, 1.1% moisture, 3.2 g ash, 24.1 g carbohydrate, 29.2 g protein, 20.3 g fiber, 42.4 g fat, 194 mg Ca, 6.5 mg Fe, 474 mg P, 0.97 mg riboflavin, 0.08 mg thiamine, and 1.9 mg niacin. This genus is reported to have hydrocyanic acid, quercetin, and rutin. Seeds contain chymotrypsin inhibitors and trypsin inhibitors. Distribution: It is native to Tropical Africa. Cultivation: Mainly collected from native plants. When cultivated, seeds are planted in rows like beans. Harvesting: Immature pods are collected and cooked immediately like other pod beans. Older pods and beans are picked and cooked as vegetables. Yields and Economics Grown and consumed locally in South Africa, mainly by natives. *Caesalpinia coriaria* (Jacq.) Willd. Common Name: Divi-divi Uses: Pods contain 40-45% tannin. Leather cured with divi-divi is as good as that tanned with oak bark. In the tanning industry, usually combined with other tanstuffs. Bruised pods yield soluble tannin-rich powder which is used for dyeing black and blue. Pods also yield good black ink. Reddish brown wood produces a red dye. Folk Medicine: The powder of the pods is astringent and used as an antiperiodic, tonic, and in the treatment of bleeding piles. Chemistry: This plant species reported to contain tannin, corilagin, hydrocyanic acid, gallotannin, phellandrene and shikimic acid. Tannin consists mostly of ellagitannin and gallotannin. Seeds contain chymotrypsin and trypsin inhibitors. Distribution: Native to tropical America and the West Indies. Introduced and cultivated in India, Pakistan, Burma, Ceylon, Java, and tropical East Africa. Cultivation: *Caesalpinia coriaria* propagated by seeds. In India, seeds sown in nurseries, seedlings of 9-15 months

old may be transplanted, spaced 7-8.5 m each, to the field during the rainy season. Watering is necessary during dry periods for 1-2 years. Mature trees require no care. Forage crops can be raised between the trees. Harvesting: Trees begin to bear in 5 years and attain full bearing capacity in 20 years. In India, trees flower and fruit twice a year (Jan.-Feb. and June-July). Fallen pods are collected daily and dried before storage. A yellowish powdery substance surrounds the few seeds and contains up to 50% of superlative tannin easily extracted at 26.5°C-32.5°C. Yields and economics: This plant species is an important source of tannin in tropical America and India, trees yield about 45-135 kg pods per year. In tropical countries, considerable quantities of this species are used locally for tanning and making black dye. Much of the divi-divi from India is imported by France and England. World supply comes from Colombia, Venezuela, Java, and India.

## **2. SOURCE OF IMPORTANT DYE**

Brazilwood, *Poa Brazil* Source of important dye used for tinting paper, calico, and other materials. By use of mordants, various colours, red, brown, violet, and black, are produced. Straight-grained, fine-textured pieces of wood are used for making violin bows. Said to be astringent and used for diarrhea. Native to the coastal forests of tropical Eastern Brazil from Bahia southward; most abundant in Pernambuco and adjacent states. Now most abundant from Niteroi, State of Rio, and in areas south of Bahia and in Alagoas. Propagates naturally by seed. Presently, harvesters must go inland to get the Wood. Trees are cut down, the bark removed and the logs taken to the factories, where the dye is extracted. Entire trees are used. Demand for Brazilwood has been materially reduced by competition of coal-tar dyes. Sparwood, Indian redwood, False sandalwood, Indian brazilwood. The tree is the source of red-wood or Brazilwood of commerce. Commercially valuable parts of the plants are the wood and pods. Wood yields a valuable red dye for silk, cotton and wool fabrics. The dye contains brazilin, which is soluble in water and alcohol. A small quantity is sufficient to dye several meters of cotton fabric. The wood is used to make a red powder known as 'abir' and 'gulai'; a red water extract is used for holy festivals in India. Pods contain ca. 40% tannin used for the production of light leather goods. Roots yield a yellow dye. The decoction of wood is a powerful emmenagogue. It contains tannic and gallic acids, which are an astringent used to relieve mild cases of dysentery and diarrhea. It is also given internally for certain skin ailments. Seeds are reported to contain chymotrypsin and trypsin inhibitors. It is native to central and south India, Burma, Pegu, Ceylon, Malaya, and Tenasserim. Generally cultivated in central India, but runs wild in many places. It is propagated easily from seed. In its native habitat, the plant is usually cultivated in the forest. Pods are gathered, pounded and put into cold water. Following 2-3 hours, the mixture is rubbed and mixed with a solution of iron sulfate. Dye is extracted from the bark by boiling water to the desired consistency and tint. The number of woodchips used varies with the amount of dye. It is an important dye-making wood, pod and bark in India, Burma and Malaya. *Caesalpinia spinosa* (Mol.) Kt. Common Names: Tara, Huarango, Guaranga Its pods contain which is used for dyeing and tanning leather of sheep and goat. It is also useful for making ink. Sometimes grown as a shrub in garden for keeping out cattle, pigs, goats, and human beings. Larger forms provide a good, durable wood. Powder within the pods used as an eyewash. Nearly 50% of the tannins are present in the pods. Native to the Cordillera Region of Bolivia, Peru, and northern Chile; also occurring in Ecuador, Colombia, Venezuela, and Cuba. Cultivated in Peru, Bolivia, Ecuador, Colombia, Venezuela, and Cuba. Planted in Peru for source of tannin and dye. Introduced to and long cultivated in North Africa, notably Morocco; also, in Tropical East Africa. It is propagation by seeds. Usually grown in nurseries and transplanted out when seedlings attain the height of 10-15 cm. Pods are collected when mature. Tannin is easily extracted from pods by steaming in water at 50°-60°C for hours at three different times. Pods contain about 48% tannin. Tanning solution has little colour, producing nearly colourless leather; pH 3.3 is favourable for fixation. Sheep and goat skin tanned with this are white, instead of red. Many pods are collected from wild trees, and are a regular article of trade in markets. The tannin is used extensively in South America and Morocco for tanning sheep and goat skins, producing an excellent light-coloured leather.

## **3. EMPEROR'S CANDLESTICK, KING-OF-THE-FOREST**

*Cassia alata* L. Ringworm bush, Emperor's candlestick, King-of-the-forest. Most likely best known as a medicinal herb. The bark contains tanning material, while the roots (juice) are used for tattooing or tribal marks in West Africa. The plant is quite attractive. Bees are attracted to the flowers. Poisonous to livestock, poultry, and fish. Leaves used medicinally, taken internally as aperient, astringent, expectorant, purgative, taeniafuge, and tonic. Leaves with lime juice given as anthelmintic. Used as an antiparasitic, the leaves contain chrysophanic acid (2.2%). An ointment of leaves in Vaseline is recognized remedy for ringworm and other parasitic skin diseases; the effect is enhanced in mixture with lime juice or common salt. Poultice of leaves used to hasten suppuration and on foul ulcers. Flowers taken internally as tonic and used for skin diseases. Seed also taken internally for skin diseases. Seeds are reported to contain trypsin and chymotrypsin inhibitors. It is reported to contain chrysoarobin, cinnamaldehyde, decanal, hydrocyanic acid, iso-chak sine, ricinoleic acid, and saponin. Common in Bangladesh

and many parts of India and Pakistan, especially the western peninsula; widespread in tropical countries. It is cultivated as a perennial herb in south and central Texas. Native to tropical America. Propagated from seeds, usually scattered about in clearings, or planted in rows at edge of forest. Because the plant is perennial and evergreen in the tropics, leaves are collected as needed. Gathered and dried leaves are finally stored in containers until needed for local therapeutic usage. Plants produce new leaves as others are harvested. Locally an important medicinal plant, especially in Africa, India, Pakistan, and other tropical areas. *Cassia auriculata* L. Avaram, Matara tea, Tanner's cassia, Tarwar Shrub best known for its astringent bark, used for tanning heavy hides where color is of minor importance. Bark contains excellent fibre that can be made into rope. Branches used as chewing sticks and toothbrushes. In India, shrub is usually browsed by goats and cattle. In India, tender pods, leaves, and flowers used as food by poor people, but not cultivated. Plants also used for revegetating barren tracts and as a green manure crop; also has ornamental flowers. Plant is considered diuretic. Leaves, fresh or dried, used in infusion for a very cooling drink. Bark is highly astringent and used in place of tannic acid or oak bark for gargles, enemas, and as an alternative. Flowers and flower-buds used in a decoction for diabetes. Seeds reported as refrigerant and attendant, and used in diabetes, chylous urine, ophthalmia, and conjunctivitis. Roots are astringent, and a decoction given as an alternative and used for skin diseases. Leaves and fruits used as anthelmintic. Bark contains 15-22% tannin. Native to India, Ceylon and Burma; cultivated in Ceylon, India, Ghana, and Tanzania, especially in dry regions. It propagates from seeds or stem cuttings. Planted 5-12.5 cm apart in rows, one furrow is closed by ploughing the next. Seed planted 10-15 cm deep, thinned during the first season. Weeding and cultivation unnecessary but stimulate growth. Vigorous plants attain a height of 3 m and girth of 11 cm in 2 years; 5.3 m and 21 cm in 4 years. When 2-3 years old, the branches and twigs are cut, twig bark is stripped and dried in small cornets. The coppiced bushes send out many shoots and these may be harvested after 1 year. Plant bushes are ready to harvest in 3 or 4 years. Stripped bark constitutes 20-23% of the twig. Tannin content increases with age, but after 3 years the increase is not considerable. Size of twigs is more important than age. Extracts for tanning leather are as effective from unstripped as from stripped bark. Yield of bark averaged about 1540 kg green bark/ha, with about 9,030 trees/ha, in 4-year-old plantation. Mainly produced in India, especially in Madras, mainly from native plants. This forms about one-third of India's requirements, the rest (ca. 28,000 MT/year), is obtained from Mysore and Hyderabad.

#### 4. STINKWEED PRIMARILY MEDICINAL

*Cassia occidentalis* L. Coffee senna, Bricho, Stypticweed, Stinkweed Primarily medicinal; all parts have some purgative effect; also, a restorative febrifuge, with reputed diuretic and sudorific properties. In Ceylon, tender pods, leaves, and flowers are eaten by the poorer people. This plant increases soil fertility, especially in exhausted peanut fields. Said to be richer in potash than *Cassia tora* or *C. sophera*. Said to be mildly toxic to various stock animals, which ordinarily avoid it. Seeds or leaves, ground up or mixed with charcoal, are used to blacken blackboards. Plant parts, e.g., roots and leaves, may be used as substitute for quinine. In Africa and Mauritius seeds used as substitute for coHee, but *Cassia occidentalis* L. Figure 25. *Cassia occidentalis* L. contain no caffeine. Undried seeds are poisonous, because of presence of phytotoxins, but roasting destroys their purgative properties. Alcoholic infusions are said to be! slightly insecticidal. Leaves used as poultices for toothache in the Dutch Indies and for headache in Malaya. Used for many and various diseases and ailments in Africa. Plant is diuretic (hence the common name piss-a-bed), febrifuge, purgative and tonic; leaves, roots, and seeds are purgative; seeds and leaves used externally in skin diseases and as an antiperiodic; root used for snakebite and in infusion used by American Indians as an antidote for various poisons. Chrysarobin, cinnamaldehyde, decanal, emodin hydrocyanic acid, isochaksine, ricinoleic acid, saponin have been reported from the genus (for relative toxicity, see Appendix). Seeds contain tannic acid, mucilage (36%), fatty oils (2.6%), emodin, and a toxalbumin. According to WOI, seed oil contains 19.7% saturated fatty acids, 31.4% linoleic acid, 30.7% oleic acid, 6.3% linolenic acid. Seeds analyzing 20.6% protein and 2.7% oil had per 16 g N: 6.2 g lysine, 1.9 g methionine, 7.8 g arginine, 4.2 g glycine, 2.3 g histidine, 3.9 g isoleucine, 6.9 g leucine, 5.1 g phenylalanine, 3.1 g tyrosine, 3.9 g threonine, 5.1 g valine, 4.6 g alanine, 10.2 g aspartic acid, 18.0 glutamic acid, 0.0 g hydroxyproline, 3.7 proline, 5.3 g serine. Chrysarobin (0.25%) has been isolated from the benzene extract of the seeds. Seeds are reported to contain chymotrypsin inhibitors. Pantropical, possibly originating in tropical America, in many places a weed. Plants propagated by seed, planted in gardens to a limited extent; rarely cultivated as a crop. Because of weedy nature, plant is copiously available for native use. Plant parts collected from natural sources by natives. Seeds, leaves, roots, or flowers collected by hand in quantities as needed. Rarely appears as a commercial product. Important plant for local medical uses in many tropical areas, especially in Africa, Philippine Islands, Hawaii, West Indies, and East Indies. *Cassia senna* L. Alexandrian senna Grown or harvested as a drug plant. Leaves and pods are source of Alexandrian senna of commerce, a drug generally preferred over East Indian senna, as it is milder, but has the same action. Used as a laxative and cathartic, generally combined with aromatics and stimulants to modify its griping effects. Dried, pulverized leaves are applied to wounds and burns. Entire plant used as a febrifuge. Purgative qualities are due largely to anthraquinone derivatives. The plant is reported to contain also rhein, aloe-emodin, kaempferol,

isorhamnetin, chrysophanic acid, sennacrol, sennapicrin, and cathartomannite. The seeds reportedly contain trypsin inhibitors. The valve of the pods is reported to contain trypsin and chymotrypsin inhibitors. Dried seeds of a species of *Cassia* called senna contained per 100 g: 346 calories, 10.3% water, 15.0% protein, 1.3% fat, 66.9 g total carbohydrate, 6.5 g fiber, 3.5 g ash, 205 mg Ca, 15.4 mg P, and 1.04 mg thiamine. Originally described from North Africa; now distributed from Egypt along Red Sea to Sudan and desert parts of Nubia. Grown in Egypt and frequently in southern Sudan. Senna is propagated by seed. In India planted in nursery beds, usually in December, transplanted in February, when 15 cm high, spaced 90 cm each way, on raised beds or well-prepared patches of open ground. Soil should be thoroughly preworked and free of weeds; vegetable compost or manure should be incorporated. Vigorous leafy plants are obtained by watering during the hottest days of April and May, but shade is not needed. Leaves and pods picked from wild and cultivated plants. In Nubia, two crops are harvested annually—one in September after the rains, the other in April. In Sudan leaves are gathered during the winter. In India, where the plant is stripped of its leaves 3 times per season, picking begins in May. Leaves are immediately spread out to sun dry. Senna leaves are graded carefully, and all foreign materials including twigs and leaves are removed. Up to 1,120 kg/ha of cured leaves may be harvested 70 days after sowing. Sudan exports about 450,000 kg senna leaves annually to the United States and pods to the United Kingdom. Southeast India also produces senna commercially. Alexandrian senna leaves by the barrel commanded ca. \$0.75/kg in 1972 and \$1.50 in 1977. In bales, the pods commanded ca. \$1.00/kg in 1977.

Carob, Algarrobo, Carob bean, John's bread, Locust, St. John's bread Carob is primarily cultivated for its fruit (pod) and seeds, both high in sugar and calcium, low in protein and fats. It is used in "health foods" as a chocolate substitute and in livestock feeds, especially for cattle. From the ground endosperm, gum is made, known as locust bean gum, gum tragacanth, tragacanth, carubin, and carob flour. The gum has great water-absorbing qualities and makes an excellent stabilizer, used in many food products, in the manufacture of paper, in cosmetics and drugs, and in the chemical industry. The pods, richer in sugar than the seeds, are popularly used in foodstuffs, juices, and flour. The sugar can be extracted from the pods by alcohol and the by-product, molasses, can be fermented to ethanol. Roast seeds have been used as a coffee substitute. Alcoholic beverages have been made from infusions of the pods. Carob is also used in textile printing, synthetic resins, insecticides, and fungicides. American imports are mostly for flavoring tobacco, and in cosmetics. The hard and heavy wood is used locally to make furniture and wheels. Bark contains ca. 50% tannin. Pod is reported to have been used as an antidiarrheal, demulcent, and resolvent. The leaf is astringent. Various portions of the plant are said to be used as antitussive, astringent, pectoral, and purgative. Carob flour has been reported to contain per 100 g: 11.2 g water, 180 calories, 4.5 g protein, 1.4 g fat, 80.7 g carbohydrate, 7.7 g fiber, 2.2 g ash, 352 mg Ca, and 81 mg P. Germ meal contains: 326 calories, 9.8% moisture, 47.3 g protein, 2.8 g fat, 34.1 g carbohydrate, 3.8 g fiber, and 6.0 g ash. The seeds contain: water, 8.9-13.6; protein, 14.4-19.7; fat, 1.8-3.1; N-free extract, 55.7-62.5; fiber, 6.9-8.3; and ash 2.3-3.6%. The pods contain: water, 3.7-24.7; protein, 2.1-7.2; fat, 1.2-4.0; N-free extract, 24.5-48.4; reducing sugars, 3.0-20.5; sucrose, 7.0-43.6; fiber, 3.1-15.3; and ash, 1.8-3.0%. Van Etten et al. reported 47% protein (dry weight) for the seed and classified the amino acids (grams per 16 g N) as follows: 5.6 lysine, 1.0 methionine, 11.8 arginine, 5.3 glycine, 2.5 histidine, 3.5 isoleucine, 6.5 leucine, 3.2 phenylalanine, 3.5 tyrosine, 3.6 threonine, 4.4 valine, 4.1 alanine, 9.0 aspartic acid, 28.0 glutamic acid, 0.1 hydroxyproline, 4.0 proline, and 5.0 serine with 92% of the N as amino acids. The genus *Ceratonia* has been reported to contain the following chemicals: isobutyric acid, lactose, maltose, saponins, and tannins. Vitamin E is also reported, along with A-amino-pimelic acid, ceratose, galactomannans (lacking in embryo, abundant in endosperm; Ahmet and Vardar, 1975), leucoanthocyanins, D-pinitol, primverose, and an unnamed alcohol. Carob groats (bruised grain) are reported to contain 10.6% water, 5.00% protein, 0.3% fat, 68.6% N-free extract (including 26.1% sucrose, 14.3% invert sugar, and 0.4% dextrin, 12.4% fiber), 3.1% ash including 0.17% phosphoric acid and 0.4m lime. Carob fruits are reported to consist of 90% pulp, 8% kernels, and 2% other materials. The kernels consist of 30-33% husk, 23-25% germ, and 42-46% endosperm. Carob bean gum is reported to contain 88% D-galacto-D-mannoglycan (ratio of galactose to mannose about 1 : 4), 4% pentosan, 6% protein, 1% cellulose, and 1% ash. Carob beans are reported to contain the following saccharides: glucose, fructose, xylose, sucrose, and two unestimated reducing disaccharides, one of which contains xylose and glucose. The nutritive value of carob nearly equals that of barley; 147 kg carob corresponding to ca. 129 kg barley, 100 kg wheat, or 70 kg beans. Seeds and commercial bean meals are reported to contain trypsin inhibitors and chymotrypsin inhibitors. Common in the eastern Mediterranean region, particularly in Cyprus, Israel, and Lebanon and occurring wild in elevated parts of Yemen, and wild or feral in Algeria and Morocco. Cultivated from antiquity in the Mediterranean Sea area at 0-500 m in latitudes 27°-42°. Introduced to California, southern Mexico, South Africa, Australia, and India. Carob may be propagated by seed, grafting or cuttings. Seeds are removed from the pods (soon after maturity, before hardening), mixed with coarse sand and kept moist in greenhouse or between layers of sterilized sacking or burlap. When they show signs of swelling and growth, they are planted in a propagating bed, composed of clay rolled and packed hard, upon which the seeds are placed and covered lightly with sand and good soil to the depth of 1.2 cm. When the seedlings show two sets of leaves they are transferred to 6.5 -cm pots containing clay soil; transplants allowed to stand 24 hr without water, then watered freely. At 12-15

cm high, they are transferred to tins or boxes 15 x 20 x 20 cm with a good potting soil. Plants 1-1.8 m tall are out planted 7 m each way in poor, rocky soil; 12-14 m each way in good fertile soil. On hillsides the trees can best be set in terraces constructed on the contour. Since seedlings are very slow to bear and sex is indeterminable for a long time, budding or grafting to a good cv is advisable. Cuttings may be, but seldom are, grown with bottom heat and careful treatment. In Israel and Cyprus, high yielding cvs are maintained by grafting in the third year to the healthiest plants. In South Mrica grafting is done from mid-May to end of June, care being taken that the bark opens easily. The best method is to graft on the branches, not the stem, leaving the smaller branches to utilize the winter deposits of sap. These branches may be cut off the following year. Seedlings may be budded the second year in the field when the stalk is about 0.8 cm in diameter. Usually grown as a dryland crop, the tree produces better under irrigation. Cultivation disturbs the root system and is not recommended. Oil or chemical herbicides may be used. Carob bears in 5-7 years. Mter flowering, the fruit requires 6-8 months to mature. Flowers appear in the fall or early winter, fruit develops slowly during the late winter and spring, and matures late the following summer or in the early autumn. From August on, the pods are knocked down with long poles. They are dried for a month, then transported to a factory for crushing. Carob bears in 5-7 years. Mter flowering, the fruit requires 6-8 months to mature. Flowers appear in the fall or early winter, fruit develops slowly during the late winter and spring, and matures late the following summer or in the early autumn. From August on, the pods are knocked down with long poles. They are dried for a month, then transported to a factory for crushing.

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