

**A REVIEW ON PHYTOCHEMICALS & PHARMACOLOGICAL ACTIVITIES,
SUBSTITUTES & ADULTERANTS OF COFFEE (COFFEA ARABICA)**

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**ABSTRACT**

More than half of the populations of the world starts their day with a mug of coffee. Most people also need coffee while working to keep them fresh and energetic. It's well appreciated for its taste, aroma, and stimulating properties. Chemically it contains polyphenols, Terpenoids, Alkanoids, Enzymes, Carotenoids, Inorganic substances Vitamins, etc. like health-related molecules which show a range of pharmacological activities such as anti-inflammatory, antioxidant, anticancer, etc. The usage of coffee probably originated in Northeast Africa, spread out to the middle East in the 15th century, and then to Europe. After oil, coffee has become the second most valuable commodity around the world. Coffee is known to boost physical and mental performance. Some research also suggests that drinking coffee regularly helps in losing weight. Besides the benefits coffee is also known to cause anxiety and Insomnia if taken in excess. As it is expensive most of the time substituted and adulterated with many other plant and plant parts. Therefore, the main aim of the review is to gather information on coffee regarding phytochemicals, pharmacological activities, substitutes, and adulterants.

Keywords: Coffee, Coffea arabica, phytochemicals, Pharmacological activities, Substitutes, Adulterants.

INTRODUCTION

Coffee is brewed from the roasted and ground seeds of the tropical evergreen coffee plants of African origin. Coffee is one of the three most popular beverages in the world alongside water and tea and one of the most profitable international commodities. There are more than 80 species of coffee found in the world. Mainly two species of coffee plants, *Coffea arabica*, and *Coffea canephora* var. *robusta*, belonging to the family Rubiaceae, supply most of the world's need for coffee. More than 700 compounds are found in coffee, which is responsible for aroma and flavors. The main Phytoconstituents present in coffee beans are *Caffeine*, *Tannin*, *Thiamine*, *Xanthine*, *Spermidine*, *Guaiacol*, *Citric acid*, *Chlorogenic acid*, *Acetaldehyde*, *Spermine*, *Putrescine*, *Scopoletin*, *Carbohydrates*, and *Sugars*, etc. It shows pharmacological activities like antihypertensive, anti-inflammatory, anticancer, antibacterial, antidiabetic,

neuroprotective, antioxidant, and wound healing properties, etc. The coffee drink is known to enhance sports performance and lower the risk of depression. Many times, drinking coffee also becomes an addiction that leads to insomnia. Due to high cost and demand, it is substituted and adulterated with many plants, plantparts, and other materials.

Morphological Description:

Plant of coffee is an evergreen shrub up to 5 meters tall when Unpruned. Leaves are opposite, dark green in color, glossy and elliptical in shape. Leaves are acuminate tipped, short petioled. The flowers are white in colour and have axillary clusters. These are very fragrant, contain drupe-type fruit and the shape of the fruit is ellipsoidal or spheroidal. In each fruit 2 locules are present and it contains one seed in each chamber.

Table 1: Taxonomical Position

Classification	
Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Asteroids
Order	Gentianales
Family	Rubiaceae
Genus	Coffea
Species	C.arabica

Chemical Contents:

The main constituents of coffee are caffeine, tannin, fixed oil, carbohydrates, and proteins. It contains 2-3% caffeine, 3-5% tannins, 13% proteins, 10-15% fixed oils. In seeds, caffeine is present as a salt of Chlorogenic acid. Traces of oil and wax is also found. The main chemical ingredients in coffee beans are Caffeine, Tannin, Thiamine, Xanthine, Spermidine, Guaiacol, Citric acid, Chlorogenic acid, Acetaldehyde, Spermine, Putrescine, Scopoletin, Carbohydrates, and Sugars.

Phytochemical Features:

Phenolic compounds- In *Coffea* Species 5-caffeoylquinic acid (5-CQA) is the most abundant soluble ester.¹

Alkaloids- The presence of monoterpenoid alkaloids is characteristics of the Rubiaceae family. Caffeine the most important alkaloid of coffee species is synthesized in the young leaves of *Coffea arabica* seedlings and immature fruits and it is accumulated in the matured leaves.²

Terpenoids- The characteristic aroma of coffee is due to a-2-furfurylthiol,4-vinylguaiacol. Some alkyl and 3-methyl butane tyrosine derivatives, furanone, acet-aldehyde, propanol, and methylpropanal .³

Enzymes-An adenosine nucleoside was purified from the young leaves of C. arabica, CV catimor shows maximum activity at PH-6.0 in citrate phosphate buffer.⁴

Carotenoids-Carotenoids which are generally present in leaf, flower, fruit, and shoot of plants, play an important role in the stabilization of lipid membranes, the photosynthesis, and the protection against strong radiation and photo-oxidative process.⁵

Inorganic substance and vitamins-Coffee also contains inorganic materials like K, Mg, Ca, Na, Fe, Cu, Mn, Zn, minerals, and other minor amount of B, CP, and PP vitamins.⁶

Phytochemical Analysis Of Plant Parts Of Coffee:

Coffee seed- Polyphenols such as Kaempferol, quercetin, ferulic acid, nicotinic acid, quinolic acid, tannic acid, and pyrogallic acids. Besides it also contains sugar, lipid, caffeine, and esters of hydroxycinnamic acid.⁷

Coffee Leaves-Phenolic acids such as caffeic acid, Chlorogenic acid, p-coumarin, ferulic acid, sinapic acids, rutin, quercetin, Kaempferol, and isoquercitrin.⁸

Coffee Coal- Caffeine, Phenols, tannins, trigonelline, Chlorogenic acids, and Caffeic acids⁹

Pharmacological Activities:

Antioxidant Potential- Coffee seed extract may have an important role in UV protection and cancer prevention because of its antioxidants.¹⁰

Effect during pregnancy and lactation- Some studies have shown that coffee consumption can cause spontaneous abortion during pregnancy due to its caffeine content. In addition, the use is not recommended during lactation because Caffeine can occur in breast milk.¹¹

Anti-cancer effect- The regular consumption of coffee reduces the feasibility of cancer of the kidney, liver, premenopausal breasts, and colon. these are due to Caffeine, Caffeic acid, Polyphenols, and heterocyclic molecules.¹²

Dermatological use- The powdered roots and stem of C. arabica can provoke an allergic reaction. Scientific tests have proven the anti-inflammatory activity of locally applied green seeds.¹³

Veterinary use- In a work,10ml of Arabic coffee seed extract were injected under the skin of a newborn calf which increased the healing time of the animals by 30% in diarrhoea controlled with the placebo effect.¹⁴

Effects on the nervous system- Coffee has a well-known stimulant effect on the central nervous system. It can increase the effects of painkillers or reduce tiredness.¹⁵

Antihypertensive activity- 5-CQA decrease in the blood pressure and reduction in BP occurred due to ferulic acid which is a metabolite of 5 CQA .¹⁶

Besides these benefits, some harmful side effects are also seen if coffee is taken into excess.

Anxiety- Coffee increases alertness. it works by blocking the effects of adenosine, a chemical in the brain that makes a person tired. Thus, drinking excess coffee leads to anxiety.

Digestive issues- Coffee is known for its laxative effect. It releases gastrin a hormone, the stomach produces that speeds up activity in the colon. Coffee stimulates bowel movements by increasing peristalsis.

Insomnia- Excess intake of coffee appears to increase the amount of time a person takes to sleep.

Addiction- If drank regularly, coffee becomes habitual. Coffee triggers brain chemicals similar to cocaine and amphetamines do. In one study,16 people who typically consumed high, moderate, or no caffeine took part in a word test after going without caffeine overnight. Only excess coffee users showed a bias for caffeine_ related words and had cravings for coffee.

Table 1: Plant / Plant parts used for Coffea arabica as Substitute and Adulterants.

Sr no	Botanical name	Family	Habitat	Eng./Hindi/Sanskrit name	Useful part	Substitutes and Adulterants
1	Abelmoschus esculentus (Linn.): Moench, Syn.Hibiscus esculentus Linn	Malvaceae	Shrub	E- Lady's finger H-Bhindi	Roasted seeds	Substitute and Adulterant ¹⁷
2	Agropyron repens (Linn.) Beauv.	Poaceae	Grass	E-Couch grass, Dog grass	Roasted root stock	Substitute ¹⁸
3	Asparagus officinalis Linn.	Liliaceae	Herb	E-Garden Asparagus H-Helyum	Seeds	Substitute ¹⁹
4	Borreria articularis (Linn.) Williams, Syn-B. hispida (Linn.) Schum	Rubiaceae	Herb	H-Madano-ghanti	Roasted seeds	Substitute ²⁰
5	Canavalia ensiformis DC.	Caesalpiaceae	Climber	E-Horse bean, Jack Bean, sword bean H-Bara sem	Roasted seeds	Substitute and Adulterant ²¹
6	Canna indica Linn.	Cannaceae	Herb	H-Indian shot, S-Sarvojaya	Seeds	Substitute ²²
7	Calisia occidentalis Lima.	Caesalpiaceae	Shrub	E-Negro coffee S-Kasamarda H-Kasondi	Roasted seeds	Substitute ²³
8	Cassia tora Linn	Caesalpinaceae	Herb	E-Ringworm plant, Taroto, The Foetid Cassia H-Chakundo	Roasted seeds	Substitute
9	Castanea sativa Mill.	Fagaceae	Tree	E-Spanish or sweet chestnut	Roasted fruits	Substitute ²⁴
10	Ceralonia siliqua Linn.	Caesalpiaceae	Tree	E-Carob Tree, St John's bread H-Kharnub	Roasted seeds	Substitute ²⁵
11	Cichorium intybus Linn	Asteraceae	Herb	E-Chicory H-Kasni	Dried roasted and powdered roots	Substitute ²⁶
12	Crotalaria pailida Aiton syn. C. stricta DC	Fabaceae	Shrub	H-Sem	Seeds	Substitute ²⁷
13	Crotalaria mucronata Desv.	Fabaceae	Shrub	S-Sana H-San	Seeds	Substitute or Adulterant ²⁸
14	Cyperus esculentus Linn.	Cyperaceae	Herb	E-Chufa, Earth almond, Rushnut, Tiger nut S-Musta, H-Chicheda	Roasted tubers	Substitute ²⁹
15	Cyrisus scoparius (Linn.) Link.	Fabaceae	Shrub	E-Scotch Broon	Roasted seeds	Adulterant ³⁰
16	Daucus carota Linn.	Apiaceae	Herb	E-Carrot, S-Garjara H-Gajar	Roasted seeds and roots	Substitute or Adulterant ³¹
17	Diospyros kaki linn. f.	Ebenaceae	Tree	E -Kaki, Persimmon tree	Seeds	Substitute or Adulterant ³²

				H-Halwa tendu		
18	Entada phaseoloides (Linn.) Merrill Syn-E. scandens Benth.	Mimosaceae	Climber	E-Elephant Creeper, Garbee Bean, Mackay Bean H-Bharabi, Chian.	Seeds and pods	Substitute or Adulterant ³³
19	Fragaria vesca Linn.	Rosaceae	Herb	E-Alpine strawberry	Rootstocks	Substitute ³⁴
20	Galium aparine Linn	Rubiaceae	Herb	E-Bed straw, Bur weed, Catch weed	Seeds	Substitute ³⁵
21	Glycine max. (Linn.) Merr.	Fabaceae	Herb	E-Coffee bean, Soybean H-Bhatwar	Leaves	Substituted ³⁶
22	Gossypium herbaceum Linn.	Malvaceae	Shrub	E-Cotton S-Karpas H-Kapas	Roasted seeds	Substitute ³⁷
23	Gymnocladus assamicus Kanjilal & Kanjilal	Caesalpiniaceae	Tree		Seed	Substitute ³⁸
24	Gymnocladus dioicus (Linn.) Koch	Caesalpiniaceae	Tree		Seeds	Substitute
25	Helianthus annuus Linn.	Asteraceae	Herb	E-Sunflower S-Suryamukhi H-Surajmukhi	Roasted seeds	Substitute ³⁹
26	Iris missourilensis Nutt	Iridaceae	Herb	E-Blue flag, Wild Iris	Seeds	Substitute
27	Juniperus communis Linn	Cupressaceae	Shrub	E-Juniper	Roasted berries	Adulterant ⁴⁰
28	Leucaean leucocephala (Lamk)de Wit Syn-L. glauca (Linn)Benth.	Mimosaceae	Tree	E-Jumpy Bean H-Subabul	Seeds	Substitute
29	Phoenix dactylifera Linn.	Arecaceae	Tree	E-Date palm S- Kharjura H-Pindakhajur	Roasted seeds	Substitute and Adulterant ⁴¹
30	Pseudotsuga menziesii Franco Syn.P. taxifolia Britton	Pinaceae	Tree	E-Green Douglas fir	Roasted and powdered leaves	Adulterant or substitute
31	Silybum marianum Gaertn.	Asteraceae	Shrub	E-Milk Thistle	Seeds	Substitute ⁴²
32	Simmondsia chinensis (Linn) Schneider	Buxaceae	Tree	E-Jojoba	Seeds	Substitute
33	Sterculia urens Roxb.	Sterculiaceae	Tree	E-Kateera gum, sterculia H-Gulu	Roasted seeds	Substitute ⁴³
34	Tamarindus indica Linn.	Caesalpiniaceae	Tree	E-Tamarind S-Chincha H-Imli	Roasted seeds	Substitute or Adulterant
35	Taraxacum officinale Weber	Asteraceae	Herb	E-The common Dandelion H-Kanphul	Roasted rhizomes and roots	Substitute and Adulterant ⁴⁴
36	Tephrosia purpurea (Linn)Pers	Fabaceae	Herb	E-Wild indigo S-Saraponkha	Seeds	Substitute and Adulterant ⁴⁵
37	Tricalysia sphaerocarpa (Hook.f.) Gamble	Rubiaceae	Tree		Berries and seeds	Substitute or Adulterant ⁴⁶

CONCLUSION

Most people in the world may be students, employees, old people, middle-aged consume coffee. Coffee is one of the most expensive beverages in the world making it get adulterated very often with different other beans and bark powders. Besides being everyone's favorite beverage, it has many health benefits as well as health hazards if taken in excess, so taking an appropriate quantity of coffee and the frequency of indulging in drinking coffee is very important. Checking for the variety and quality of coffee is equally important if one wants to avoid getting the adulterated form of coffee.

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