Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 1945-1948
Received: 22-09-2019
Accepted: 26-10-2019

Keerthy SP
Department of Postgraduate, Studies and Research Division of Pharmacognosy and Photochemistry Sarada Vilas College of Pharmacy, K. M. Puram, Mysore-04, Karnataka, India

Dr. K Hanumanthachar Joshi
Department of Postgraduate, Studies and Research Division of Pharmacognosy and Photochemistry Sarada Vilas College of Pharmacy, K. M. Puram, Mysore-04, Karnataka, India

Corresponding Author:
Keerthy SP
Department of Postgraduate, Studies and Research Division of Pharmacognosy and Photochemistry Sarada Vilas College of Pharmacy, K. M. Puram, Mysore-04, Karnataka, India

The pharmacological importance of *Colocasia esculenta* Linn: A review

Keerthy SP and Dr. K Hanumanthachar Joshi

Abstract
Colocasia esculenta (CE) Linn. (Family: Araceae) is an annual herbaceous plant with a long history of usage in traditional medicine in several countries across the world, and is grown for its edible corm as a staple foods throughout the tropical and subtropical regions. In India it is known as Aravi, Alukam, Kesavedantu, Chamadumpa. Corm and leaves of this plant are widely used as vegetables in Indian traditional food system. It was a widely used as a vegetable crop for nutritional and medicinal purposes. Phytochemical analysis showed that the major constituents of *Colocasia esculenta* leaves are flavonoids, β-sitosterol, and steroids, The leaves of the plant are reported to possess huge vitamin C content and the root is rich in starch and essential nutrient such as thiamine, riboflavin, niacin, oxalic acid. The plant also has the property to reduce fever and pain. The pharmacological studies revealed that the plant exerted many pharmacological activities, including central nervous effects, antioxidant, anti-inflammatory, analgesic, anti-lipid Peroxidative activity, antidiabetic, antihepatotoxic and antimicrobial effects. This review was designed to highlight the chemical constituents and pharmacological effects of Colocasia esculenta.

Keywords:

Introduction
Plants have played a significant role in maintaining human health and improving quality of human life since long and have served humans well as valuable components of medicines, seasoning, beverages, cosmetics, and dyes. The popularity of herbal medicine in recent times is based on the premise that plants contain natural substances that can promote health and alleviate illness. Therefore, the focus on plant research has increased all over the world and a large body of evidence show immense potential of medicinal plants used in various traditional system. There are many herbs that are predominantly used to treat cardiovascular, liver, central nervous system (CNS), digestive, and metabolic disorders. The plant show their potential to produce significant therapeutic effect, they can be useful as drug or supplement in the treatment or management of various diseases.
Colocasia esculenta Linn. (Family: Araceae) [Figure 1] is also known as *Arum esculentum* L. and Colocasia antiquorum Schott.[1] It is commonly called as taro (English); alavi, patarveliya. They are herbaceous perennial plants with large corms on or just below the ground surface. The leaves are large to very large, 20–150 cm (7.9–59 in) long, with a sagittate shape. The elephant's ear plant gets its name from the leaves, which are shaped like a large ear or shield. The plant reproduces mostly by means of rhizomes (tubers, corms) but it also produces "clusters of two to five fragrant inflorescences in the leaf axils". [2] Stem of this plant are used as vegetable in Indian traditional food system from many decades. *Colocasia esculenta* is a tropical plant grown primarily for its edible corms, the root vegetables whose many names include Taro and Eddoe. It is believed to be one of the earliest cultivated plants [3]. The (Gujarati); arvi, kachalu (Hindi); alu (Marathi); alupam, alukam (Sanskrit); and sempu (Tamil). Geographically, it occurs throughout India and is cultivated worldwide [4, 5].

Botanical description Parts used: Leaves and corms [Figure 2]
- *Colocasia esculenta* Linn. is a tall herb [Figure 1], tuberous or with a stout short caudex, flowering and leafing together.
- Leaves are simple, with a stout petiole, lamina peltate, ovate-cordate or sagittate-cordate. Spadix shorter than the petiole and much shorter than the spathe, appendix much shorter than the inflorescence. The leaves are large to very large, 20–150 cm (7.9– 59 in) long, with a sagittate shape. The elephant's-ear plant gets its name from the leaves, which are shaped like a large ear or shield. The plant reproduces mostly by means of rhziomes (Tubers, corms) but it also produces "clusters of two to five fragrant

inflorescences in the leaf axils" [6]. Like other members of the family, the plant contains an irritant which causes intense discomfort to the lips, mouth and throat.

- Female inflorescence short, male inflorescence long, cylindrical, usually interposed neuters between the two. Appendix erect, elongate-conical or fusiform, subulate or abbreviate. Male flowers 3-6 androus.
- Female flowers 3-4 gynous; ovary ovoid or oblong, one-locular; ovules several or many, biseriate; style short in the beginning, later on stigma depressed-capitate, very shortly 3-5 sulcate.
- Berries obconic or oblong, many seeded. Seeds oblong, sulcate. Albumen copious; embryo axile. Stem above ground, or slightly swollen at the base of the leaf-sheaths, arising from a hard tapering rhizome or in cultivated forms a tuberous rhizome suckers and stolons sometimes present.
- Spadix much shorter than the spathe rather than slender. Female inflorescence as long as the sterile male inflorescence. Appendix much shorter than the inflorescence, style very short; stigma discoid [7].

Taxonomy [8]:
Kingdom: Plantae
Order: Alismatales
Family: Araceae
Subfamily: Aroideae
Tribe: Calocasiodeae
Genus: Colocasia
Species: C.esculenta

Fig 1: Colocasia esculenta

Fig 2: Corm of Colocasia

Fig 3: Leaf of Colocasia,

General Description [9].
Type: Bulb
Family: Araceae
Zone: 8 to 10
Height: 3 to 6 feet
Spread: 3 to 6 feet
Bloom Time: July to August
Bloom Color: White
Bloom Description: Yellowish-white
Sun: Full sun to part shade
Water: Medium to wet
Maintenance: Medium
Flowers: Showy Flowers
Leaves: Green in Colorful
Tolerates: Wet Soil
Uses: Rain Garden, Suitable as Annual, Water Plant

Active constituents of Colocasia esculenta
There are two important pharmacologically active constituent is present in leaf extract of *Colocasia esculenta* namely flavonoids and triterpinoids.
Flavanoids present in the Colocasia leaf extract are orientin, isoorientin, isovitexin, vicenin-2,orientin7-Oglucoside, isovitexin 3'-O-glucoside, vitexin X''-Oglucoside, leteolin 7O-glucoside[10] Phytochemical investigations on the Colocasia extracts have shown the presence of anthocyanins such as cyanidin-3-glucoside, pelargonidin-3-glucoside and cyanidin-3-rhamnoside, which have antioxidant activities as evident from previous studies [11, 12, 13].Therefore, anthocyanins may be responsible for the hepatoprotective as well as anti-lipid peroxidative activity that was observed associated with the leaf juice of Colocasia esculenta.

Pharmacological properties
Antidiabetic Activity [14]:
The ethanol extract of C. esculenta(EECE) leaves were subjected to phytochemical investigation and evaluated for antidiabetic activity on blood glucose level and on the body weight in alloxan induced diabetic rats. EECE (100, 200 and 400 mg/kg) and metformin (450mg/kg) were administered orally in alloxan (120 mg/kg, i.p.) induced diabetic rats. In acute oral toxicity (AOT 425) study, administration of EECE no mortality upto 5000 mg/kg was observed. The onset of reduction of blood glucose was observed at 4 h (96 mg/dl), peak at 6 h (120 mg/dl) but antihyperglycaemic effect waned at 24 h. In subacute study, maximum reduction in blood glucose was observed (174.34 mg/dl) at the dose of 400 mg/kg on 14th day. EECE prevented further loss of body weight. EECE (400 mg/kg) was found to have significant ($p<$ 0.001) blood glucose lowering effect. Preliminary Phytochemical investigation revealed the presence of

alkaloids, flavonoids, saponins and tannins as the major constituents in the ethanol extract. These results suggest that EECE (400 mg/kg) showed antihyperglycaemic activity in alloxan induced diabetic rats.

Antimicrobial activity [15]:
The in-vitro antimicrobial activity in aqueous extract of *Colocasia esculenta* (AECE) leaves were studied against gram positive bacterial strains i.e. Streptococcus mutans (MTCC-890), Bacillus subtillis (MTCC121), gram negative bacterial strains i.e Klebsiella pneumoniae (MTCC-109), Pseudomonas fragi (MTCC-2458), Escherichia coli (MTCC-483) and fungal strains Aspergillus niger (MTCC-281) Candida albicans (MTCC-227). The antimicrobial activity of AECE was determined by agar well diffusion methods at the concentrations ranging from 100500µg /ml. Standard antibiotic discs were used as positive controls. AECE gave maximum activity against Streptococcus mutans amongst the selected microbial strains. In conclusion, the *Colocasia esculenta* extract exhibited good antimicrobial activity against some of tested bacteria and fungus at low concentration. The results provide promising information for the potential use of *Colocasia esculenta* aqueous extract in the treatment of infection.

Anti-lipid per oxidative activity [16]:
The effect of free radicals was studied on liver cells *in vitro* by using rat liver slice model. The liver slices were incubated in presence of cytotoxic concentrations of CCl4 and acetaminophen. Co-incubation of liver slices with the hepatotoxins and *Colocasia esculenta* leaf juice was conducted to assess the potency of natural components of *Colocasia esculenta* leaf juice in scavenging the free radicals formed due to the metabolism of CCl4 and acetaminophen. The evaluation was carried using the Thio-Barbituric Acid Reactive Substances and the total glutathione levels in the liver tissue. After the statistical treatment results revealed that the *Colocasia esculenta* whole leaf juice prevented the elicit of lipid peroxidative reactions caused due to the presence of free radicals generated by the hepatotoxins. Simultaneously marked elevations and prevention of depletion of total tissue glutathione were observed in presence of *Colocasia esculenta* whole leaf juice. From the results it is concluded that the *Colocasia esculenta* whole leaf juice contains free radical scavenging efficacy.

Antifungal activity [17]:
The antifungal activity of taro was evaluated, along with molecular cloning and recombinant gene expression studies. A cDNA clone, designated CeCPI, encoding a novel phytocystatin was isolated from taro corms using both degenerated primers/ reverse transcription-polymerase chain reaction (RTPCR) amplification and 5′-/3′-Rapid amplifi cation of cDNA ends (RACE) extension. Sequence analysis revealed that CeCPI is phylogenetically closely related to Eudicots rather than to Monocots, despite taro belonging to Monocot. Recombinant GST–CeCPI fusion protein was over-expressed in Escherichia coli and its inhibitory activity against papain was identified on gelatin/sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). These results confirmed that recombinant CeCPI protein exhibited strong cysteine protease inhibitory activity. Thus, the investigation clearly revealed a toxic effect of the plant on the mycelium growth of phytopathogenic fungi.

Anti-inflammatory activity [18]:
The anti-inflammatory activity of the ethanolic extracts of the leaves of CE in Wistar rats using the carrageenan-induced left hind paw edema, carrageenan induced pleurisy, and cotton pellet induced granuloma model. The results indicated that the ethanolic extract produced significant ($p< 0.05$) anti-inflammatory activity when compared with the standard and untreated control.

Antihepatotoxic/hepatoprotective study [19]:
The antihepatotoxic and hepatoprotective studies were carried against two well-known hepaotoxins paracetamol and CCl4 using *in vitro* liver slice method. The free radicals generated by CCl4 and paracetamol cause oxidative stress as well as damage various cell organellaes consequently resulting in injury to the hepatocytes. The extent of damage caused by these free radicals as well as evaluation of antihepatotoxic and hepatoprotective efficacy associated with the Colocacia esculenta leaf juice was measured using the leakage of marker enzymes of liver function *viz* AST, ALT and ALP in the incubation medium. In presence of CCL4 as well as paracetamol there was increase in the levels of marker enzymes indicating hepatotoxicity of these compounds. At one and two hours interval insignificant alterations were observed in the enzymes levels. Marked elevations of toxicity marker enzymes were noted at four hours in presence of CCl4 as well as paracetamol. However the leaf juice of Colocacia esculenta remarkably declined the leakage of AST, ALT and ALP in the medium indicating hepatocyte integrity. The investigation is supportive to conclude that the Colocacia esculenta leaf juice as a whole possesses antihepatotoxic and hepatoprotective efficacy when tested *in vitro* using rat liver slice model.

Nervine tonic [20]:
The neuropharmacological activities of hydroalcoholic extract of leaves of CE using several experimental models. In the study, adult Wistar albino rats were subjected to behavior despair and elevated plus maze (EPM) tests. Thiopental induced sedation and rotarod tests were conducted on Swiss albino mice. The effects of the plant extract on anxiety, depression, thiopental-induced sleeping time, and rotarod performance were evaluated. The anxiolytic activity of extract (100, 200, and 400 mg/ kg) per os (p.o.) was characterized by increased time spent and number of entries in open arms in the EPM paradigm as compared to control group ($P< 0.001$). The extract (100, 200, and 400 mg/kg, p.o.) showed a dose-dependent significant reduction in the duration of immobility ($P< 0.01$) in the behavior despair test. The plant extract at doses 50 and 100 mg/kg, i.p. was found to produce a significant reduction in motor coordination ($P< 0.001$) and prolongation of thiopental-induced sleeping time ($P< 0.001$). Thus, results of the study showed that the plant possesses various neuropharmacological activities such as antidepressant, anxiolytic, sedative, and smooth muscle relaxant activity.

Applications of colocasia [21]:
- Colocasia (Taro) leaves as well as yellow-fleshed roots have significant levels of phenolic flavonoid pigment antioxidants such as ß-carotenes, and cryptoxanthin along with vitamin A. 100 g fresh taro leaves provides 4825 IU or 161% of RDA of vitamin A. Altogether, these compounds are required for maintaining healthy mucus

membranes, skin and vision. Consumption of natural foods rich in flavonoids helps to protect from lung and oral cavity cancers.

- Colocasia leaf juice extract is a good stimulant, expectorant, astringent, appetizer and otalgia.
- Colocasia juice of the corm is used in cases of alopecia.
- Colocasia juice expressed from the leaf stalks with salt is used as an absorbent in cases of inflamed glands and buboes.
- Colocasia juice of the petiole is stypic, and is used to arrest arterial hemorrhage.
- Colocasia corm is one of the finest source dietary fibers; 100 g flesh provides 4.1 g or 11% of daily requirement of dietary fiber. Together with slow digesting complex carbohydrates, moderate amounts of fiber in the food helps gradual rise in blood sugar levels.
- Colocasia, the corms provide healthy amounts of some important minerals like zinc, magnesium, copper, iron, and manganese. In addition, the root has very good amounts of potassium. Potassium is an important component of cell and body fluids that help regulate heart rate and blood pressure.
- Leaf juice of this plant is applied over scorpion sting or in snake bite as well as it is used in food poisoning of plant origin.
- Cooked vegetable contains mucilage and found to be an effective nervine tonic.
- Decoction of the peel is given as a folk medicine to cure diarrhea.
- Increases body weight, prevents excessive secretion of sputum in asthmatic individuals.
- Juice of the corm is used in cases of alopecia.
- Internally, it acts as a laxative, demulcent, anodyne, galactagogue and is used in cases of piles and congestion of the portal system; also used as an antidote to the stings of wasps and other insects.
- Corm is used by people of the Munda tribe as a remedy for body ache.

Conclusion

Colocasia esculanta is a succulent herb, with clusters of long heart or arrowhead shaped leaves that point earthwards, which grows on erect stems that may be green, red black or variegated. The plant has been studied for various pharmacological activities like antifungal, anticancer, antibacterial, antioxidant, hypolipidemic, hepatoprotective, anti diabetic, antihyperlipidemic activity. Thus Colocasia leaf extract has been proved to be a medicinal active plant for the treatment of various health issues. The popularity of herbal medicine in recent times is increasing based on the premise that plants contain natural substances that can promote health. Chemically, the plant contains various biologically active phytoconstituents such as flavonoids, sterols, glycosides, and other micronutrients. Therefore, it is necessary to exploit it to its maximum potential in the medicinal and pharmaceutical field.

References

1. Wiersema JH, Leon B. World Economic Plants, A standard reference. New York: CRC Press, 1999, 143.
2. Brown, Deni. Aroids. Plants of the Arum Family. Timber Press, Oregon. 2006, 250.
3. Arulmozhi s, Mazumber PM, Ashok P, Narayan LS. Pharmacological activities of *Alstonia scholaris* Linn. (Apocynacea)- A review. Pharmacog Rev. 2007; 1:1 63-70.
4. Sheth AK. The Herbs of Ayurveda. Ahmedabad: A.K. Sheth Publishers, 2005, 356.
5. Pullaiah T. Encyclopedia of World Medicinal Plants. New Delhi: Regency Publication. 2006; 6:18.
6. Bradbury J Howard, Nixon, Roger W. The acridity of raphides from the edible aroids. Journal of the Science of Food and Agriculture. 1998; 76(4):608-616.
7. Kirtikar KR, Basu BD. Indian Medicinal Plants. Dehradun: International Book Distributors. 2005; 4:2615.
8. Colocasia Schott. Taxonomy for Plants. National Germplasm Resources Laboratory, Beltsville, Maryland: USDA, ARS, National Genetic Resources Program. www.ars-grin.gov/cgi-bin/npgs/html/genus.Pl2 8 16.
9. www.missouribotanicalgarden.org/.../colocasia esculenta-blac...
10. Iwashina T, Konishi T, Takayama A, Fukada M, Ootani S. Isolation and identification of the flavanoids in the leaves of taro. Ann Tsukuba Botanical Garden. 1999; 18:71-4.
11. Noda Y, Kaneyuki T, Mori A, Packer L. Antioxidant activities of pomegranate fruit extract and its anthocyanidins: Delphinidin, cyanidin, and pelargonidin, Journal of Agricultural Food Chemistry. 2002; 50:166-171.
12. Cambie RC, Ferguson LR. Potential functional foods in the traditional Maori diet, Mutation Research, Fundamental and Molecular Mechanisms of Mutagenesis. 2003; 523(524):109-117.
13. Kowalczyk E, Kopff A, Fijalkowski P, Niedworok J, Blaszczyk J, Kedziora J. Effects of anthocyanins on selected biochemical parameters in rats exposed to cadmium, Acta Biochimica Polonica. 2003; 50:543-548.
14. Kumawat NS, Chaudhari SP, Wani NS, Deshmukh TA, Patil VR. Antidiabetic activity of ethanol extract of *Colocasia esculenta* leaves in alloxan induced diabetic rats International Journal of Pharm Tech Research CODEN (USA). 2010; 2(2):1246-1249. IJPRIF ISSN: 0974-4304.
15. Singh B, Namrata, Lokendra Kumar, Dwivedi SC. Antibacterial and Antifungal Activity of *Colocasia esculenta* Aqueous Extract: An Edible Plant Journal of Pharmacy Research. 2011; 4(5):1459-1460.
16. Bhagyashree RP, Hussein M. Aanti-Lipid Peroxidative Activity of *Colocasia esculenta* leaf Juice against Ccl4 and Acetaminophen Mediated cell Damage International Journal of Pharmaceutical Applications ISSN 0976-2639. 2011; 2:141-149.
17. Yang AH, Yeh KW. Molecular cloning, recombinant gene expression, and antifungal activity of cystatin from taro (*Colocasia esculenta* cv. Kaosiung no.1). Planta Med. 2005; 221:493-501.
18. Shah BN, Nayak BS, Bhatt SP, Jalalpure SS, Sheth AK. The anti-inflammatory activity of the leaves of *Colocasia esculenta*. Sau Pharm J. 2007; 15:3-4.
19. Bhagyashree RP, Hussein M. A Antihepatotoxic Activity of *Colocasia esculenta* leaf Juice International Journal of Advanced Biotechnology and Research. 2011; 2:296-304. ISSN 0976-2612, http://www.bipublication.com.
20. Kalariya M, Parmar S, Sheth N. Neuropharmacological activity of hydroalcoholic extract of leaves of Colocasia esculenta. Pharm Biol. 2010; 48:1207-12.
21. Kirtikar KR, Basu BD. Indian medicinal plants. Dehradun: International Book distributors. 2005; 4:2615.