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SUMMARY & CONCLUSION
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SUMMARY AND CONCLUSION

In present studies the leaf and fruits of *Gmelina arborea* and *Careya arborea* were selected on the basis of utility in traditional system of medicine. The studies were focused on their pharmacognostical, phytochemical and pharmacological investigation.

The plants were identified by Dr. P.S. Nagar, Botany department of M. S. University of Baroda, Vadodara.

Pharmacognostical study includes morphology, physicochemical and microscopic evaluation of leaf, fruits and powder of *Gmelina arborea* and *Careya arborea*. A leaf of *G. arborea* was small, opposite, reticulate venation with long petiole whereas leaf of *C. arborea* was broadly ovate, alternate, wavy margin; pinnate venation and short petiole. A fruits of *G. arborea* was small, drupe, strong, disagreeable odour, obovoid or pyriform and with calyx whereas *C. arborea* was fleshy indehiscent, globose, agreeable odour and crowned with calyx limb. A seeds of *G. arborea* was small, obovoid or pyriform and with calyx having strong disagreeable odour whereas *C. arborea* was oval ellipsoid or oblong with agreeable odour.

Leaves of *G. arborea* and *C. arborea* were dorsiventral. *G. arborea* leaf in transverse section showed covering trichome and anomocytic stomata while *C. arborea* leaf showed anisocytic stomata and cluster of calcium oxalate crystals. *G. arborea* fruits in transverse section showed epicarp, mesocarp and vascular strand while *C. arborea* fruit showed epicarp, hypodermis, mesocarp, vascular bundle and sclerides. The transverse section of seeds of *C. arborea* showed epidermis, stone cell layer, collapsed parenchyma and endosperm.

Leaf powder of *G. arborea* was showed the presence of anomocytic stomata, covering trichomes with fine vascular strands while *C. arborea* leaf powder was showed anisocytic stomata, calcium oxalate, and vascular strands. Fruit powder of *G. arborea* showed presence of epidermal cells, mesocarp, pitted parenchyma, vascular strand and sclerides while *C. arborea* fruits powder showed fibers, sclereids, mesocarp fragments and epicarp cells. Quantitative microscopy showed that the value of stomata index, palisade ratio, vein islet number and vein termination number were less in *C. arborea* than *G. arborea*. 
Physicochemical study revealed that total ash, foaming index and acid insoluble ash was more in *C. arborea* leaf than in *G. arborea* leaf. *G. arborea* fruits contain more water soluble extractives, total ash, loss on drying and foreign matter, while alcohol soluble constitutes were higher in *C. arborea* fruit. Acid-insoluble ash was almost same in both the fruits. Qualitative chemical examination of extracts of *G. arborea* and *C. arborea* leaves showed the presence of alkaloid, carbohydrates, saponins, steroid, flavonoid and phenolic compound. A fruit of *G. arborea* contained carbohydrates, alkaloid, saponins, flavonoid, phenolic compound and alkaloids whereas *C. arborea* fruits contained carbohydrates, saponins, alkaloid, flavonoid, phenolics compound and sterols.

Result of TLC study showed that in solvent system for steroid and triterpenoids after derivatization with anisaldehyde sulphuric acid reagent petroleum ether extract of *G. arborea* leaf had demonstrated 7 purple spots and a green spot; while, *C. arborea* demonstrated 7 pink spots and 3 greenish-brown spots. Toluene extracts of *G. arborea* leaf had demonstrated 2 pink, a greenish yellow and 2 purple spots; while, *C. arborea* demonstrated a purple and 2 brownish purple spots. Chloroform extracts of *G. arborea* leaf had demonstrated 2 pink and 3 purple spots; while, *C. arborea* demonstrated 5 purple and a green spots. Ethyl acetate extracts of *G. arborea* leaf had demonstrated 5 purple and a yellow spot while, *C. arborea* demonstrated 6 purple and a green spots. Ethyl acetate extracts of *G. arborea* leaf had demonstrated 2 pink and 2 purple spots while, *C. arborea* demonstrated 4 pinkish-purple spots. Methanol extracts of *G. arborea* leaf had not demonstrated any spots while, *C. arborea* demonstrated a brownish purple and 4 pinkish-purple in solvent system for steroid and triterpenoids after derivatization with anisaldehyde sulphuric acid reagent. Water extracts of *G. arborea* leaf had demonstrated 3 purple and a greenish brown green spot while, *C. arborea* demonstrated 3 purple and 2 greenish brown spots.

In solvent system for phenolics after derivatization with alcoholic FeCl₃ reagent, ethyl acetate extracts of *G. arborea* leaf had demonstrated 3 black spots while, *C. arborea* demonstrated 4 black spots. Methanol extracts of *G. arborea* leaf had demonstrated 4 purple and 2 yellowish green spot while, *C. arborea* demonstrated 5 purple and a green spots. Methanol extracts of *G. arborea* leaf had demonstrated 3 black spots while, *C. arborea* demonstrated 3 black spots.
arborea demonstrated 4 black spots. Water extracts of G. arborea leaf had demonstrated 3 black spots while, C. arborea demonstrated 2 black spots. Ethyl acetate, methanol and water extract of C. arborea leaf had shown 4 black spots, while ethyl acetate and methanol extract of G. arborea leaf had shown 3 black spots in solvent system for phenolics after derivatization.

Fluorescence analysis of G. arborea and C. arborea leaf showed that drug powder itself and with picric acid had given similar fluorescence in visible and UV light whereas with HCl, H₂SO₄ and aqueous NaOH had shown the same fluorescence in visible light. Both the plants had given distinguish fluorescence with NaOH (alcohol), nitric acid, acetic acid, NH₃ and KOH (alcohol) under visible and UV light.

Fluorescence analysis of G. arborea and C. arborea fruits showed that drug powder itself had given similar fluorescence in visible and UV light. Both the plants had given distinguish fluorescence with, HCl, H₂SO₄, aqueous NaOH, NaOH (alcohol), nitric acid, acetic acid, NH₃ and KOH (alcohol) under visible and UV light. These reagents can be used for differentiating G. arborea and C. arborea fruits powder.

Quantitative phytochemical analysis showed the highest amount of phenolic was found in ethyl acetate extract of C. arborea fruits while the lowest in aqueous extract of leaf of G. arborea. The methanol and ethyl acetate extract of leaves and fruits of G. arborea showed higher amount of flavonoid than C. arborea. The aqueous extract of leaves and fruits of C. arborea showed higher amount of flavonoid than G. arborea. G. arborea leaf and fruits contained 0.12%w/w and 0.05%w/w total alkaloid respectively. Highest amount of alkaloid was found in C. arborea leaf. The highest amount of saponin was found in methanol extract of C. arborea leaf. Methanol and aqueous extract of leaf and methanol extract of fruit of C. arborea contain higher amount of saponin than G. arborea. Aqueous extracts of G. arborea fruits contain higher amount of saponin than C. arborea.

The HPTLC quantification of gallic acid in methanol and ethyl acetate extract of fruit and leaf of C. arborea showed the highest amount of gallic acid in ethyl acetate extract. The
ethyl acetate and methanol extract of *C. arborea* fruits contain more amount of gallic acid than leaves extracts.

Toxicity studies in Wistar albino rats revealed that no lethality or toxic reactions were found at the dose of 2000mg/kg body weight indicating the non-toxic nature of the methanol extract of fruit and leaf of *G. arborea* and *C. arborea*.

The antiallergic activity of methanol extracts of *G. arborea* and *C. arborea* fruit and leaves were evaluated using histamine induced contraction on guinea pig ileum, acetylcholine induced contraction on rat ileum and passive paw anaphylaxis.

The methanol extract of leaves & fruits of *G. arborea* and *C. arborea* were exhibited dose dependent significant antiallergic activity by inhibition on histamine induced contraction of guinea pig ileum. The methanol extract of leaves of *G. arborea* showed the highest inhibition than *C. arborea* leaf extract while methanol extract of fruits of *G. arborea* and *C. arborea* showed almost identical inhibition.

The antiallergic activity by inhibition on acetylcholine induced contractile response on rat ileum methanol extract of fruit and leaves of *G. arborea* and *C. arborea* fruits had exhibited significant dose dependant inhibition. Methanol extract of *C. arborea* leaf showed significant dose dependant increase on acetylcholine induced contractile response on rat ileum. This may be due to cholinergic activity or cholinesterase inhibitory activity or direct contractile activity of phytoconstituents saponin and alkaloid, may be responsible for increasing contractile response of acetyl choline on rat ileum.

Methanol extract of *G. arborea* leaves and fruits showed dose dependent significant antiallergic activity in passive paw anaphylaxis rats. Antiallergic activity in all extracts and dexamethasone were increased up to 2hrs and then after decline. Methanol extract of *G. arborea* leaf have shown maximum antiallergic activity whereas methanol extract of *C. arborea* leaf exhibited minimum antiallergic activity and fruits of *G. arborea* and *C. arborea* had shown almost same antiallergic activity after 1hr, 2hr, 3hr and 4hr.

Antiallergic activity of methanol extract of leaf and fruits of *G. arborea* and *C. arborea* in isolated guinea pig ileum, isolated rat ileum and passive paw anaphylaxis in rats
models may be attributed due to presence phytoconstituents like carbohydrate, saponin, alkaloid, flavonoid, tannin and phenolics.

Methanol and ethyl acetate extract of *G. arborea* and *C. arborea* leaves & fruits had exhibited dose dependent antioxidant activity in DPPH free radical scavenging model. The ethyl acetate extract of fruits and leaf of *G. arborea* and *C. arborea* showed more radical scavenging activity than methanol extract of fruit and leaf of both the plants.

The IC$_{50}$ value indicates that ethyl acetate extract of both plants had shown higher antioxidant activity than methanol extract. Methanol and ethyl acetate extract of *G. arborea* fruits were found with more antioxidant activity than leaf. Ethyl acetate extract of fruits of *G. arborea* showed the higher radical scavenging activity than methanol extract of fruit, methanol and ethyl acetate extract of leaves of *G. arborea*. Methanol extract of leaf of *C. arborea* was showed more antioxidant activity than fruit. While ethyl acetate extract of leaf of *C. arborea* was found less antioxidant activity than fruit. Ethyl acetate and methanol extract of fruit and leaves of *C. arborea* showed higher free radical scavenging activity than *G. arborea* fruit and leaf extract. Ethyl acetate extract of fruits of *C. arborea* showed the highest radical scavenging activity whereas methanol extract of *G. arborea* leaf exhibited the lowest radical scavenging activity.

Antioxidant activity by FeCl$_3$ model showed that the ethyl acetate extract of fruits and leaf of *G. arborea* and *C. arborea* showed more reductive potential than methanol extract of fruit and leaf of both the plants. Methanol and ethyl acetate extract of leaves & fruits of *G. arborea* and *C. arborea* had exhibited dose dependent reductive potential.

Antioxidant activity of methanol and ethyl acetate extract of leaf and fruits of *G. arborea* and *C. arborea* in DPPH free radical scavenging and reducing assay by FeCl$_3$ models, may be attributed due to presence phytoconstituents like carbohydrate, saponin, alkaloid, flavonoid, tannin and phenolics.

In present investigation therefore justifies traditional therapeutic claim of *G. arborea* and *C. arborea* in treatment of allergic condition. However further phytochemical investigation may provide identification and isolation of specific compound which may be responsible for antioxidant and antiallergic activity.