**Review Article**

**Medicinal values of a horticultural plant - *Coleus hadiensis* (Forssk.) A. J. Paton**

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**Abstract**

*Coleus hadiensis* (Forssk.) A.J.Paton is a horticultural herb that goes to the *Lamiaceae* family. This plant species has been using to treat diarrhea, skin and digestive disorders, diabetes, and carcinoma in ethnomedicines. This minireview work purposes to analyze, summarize, and document the reported bioactivities of *C. hadiensis*. Suitable published works were obtained employing the Web of Science, Scopus, PubMed, Semantic Scholar, and ScienceDirect databases from 1900 to December 2020. Hitherto, *in vitro* level of scientific evidence is the highest level of scientific evidence available for the bioactivities of this plant species. Various parts of *C. hadiensis* exhibited antioxidant, antibacterial, anti-inflammatory, anticancer, and antimalarial activities in a range of assays. To date, eight bioactive (antimalarial and antioxidant) compounds have been isolated from *C. hadiensis*. This minireview analyzed, summarized, and documented the reported bioactivities of *C. hadiensis*. In addition, this minireview provides a basis for further bioactivities researches using *C. hadiensis* in future.

**1. Introduction**

*Coleus hadiensis* (Forssk.) A.J.Paton [synonyms: *Plectranthus hadiensis* (Forssk.) Schweinf. ex Sprenger; *Plectranthus zatarhendi* var. tomentosus (Benth.) Codd] is a horticultural herb that goes to the *Lamiaceae* family (Figure 1). This plant species grows up to

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1.5 m high and 1 m broad. Its stems are semi-succulent and red at the lowest part. Leaves are alternately organized and they are oval to round shape, from 35 to 100 mm broad, soft, gentle, furry, occasionally multicolored. The blossoming is 50 cm lengthy and contains lateral divisions. The flowers are white or violet and exist 1 to 3 cm at a distance. The conservation status of *C. hadiensis* is Least Concern and it is usually grown in forest, and grassland. The grow soil is well drained rich soil (Kew Science, 2020). It is native to Asia (Sri Lanka, Maldives, and Yemen) and Africa (Angola, Mozambique, Malawi, South Africa, Ethiopia, Eritrea, Kenya, Chad, Egypt, Djibouti, Swaziland, Rwanda, Zimbabwe, Somalia, Zaïre, Tanzania, and Uganda) (Kew Science, 2020). *C. hadiensis* has the name Iruveli in Tamil. This plant species has been using to treat diarrhea, skin and digestive disorders, inflammations, coughs, diabetes, and carcinoma in ethnomedicines (Lukhoba et al., 2006; Van Zyl et al., 2008; Rice et al., 2011; Menon et al., 2013; Sathasivampillai et al., 2015; 2017; 2018; Sripathi et al., 2018). Phytochemicals including rosmarinic acid, chrysosplenol D, desacetyl plectranthone, quercetin, casticin, ayanin, (+)-plectranthone, piperitone oxide, L-fenchone, β-farnesene, copaene, 2,3-dimethyl hydroquinone, α-caryophyllene, 1,8-naphthalenedione, limonene, copaene, 8,11,15-eicosatrienoic acid, β-cubebene, β-farnesene, α-caryophyllene, 2-isopropenyl-5-methylhex-4-enal, germacrene D, piperitone oxide, δ-cadinene, disophenol, p-cymen-8-ol, isolongifolan-8-ol, δ-cadinol, α-hydroxymyristic acid, p-cymen-3-ol, octern-3-ol, linalool, nerol, z-citral, geraniol, neryl acetate, α-copaene, geranyl acetate, α-cadinene, α-cadinol, β-cubebe, and valencene have been discovered in this plant species (Menon and Gopalakrishnan, 2015a; Sripathi and Ravi, 2017; Sripathi et al., 2018; Ji et al., 2019).

As there is no systematic review regarding the bioactivities of *C. hadiensis*, this minireview work purposes to analyze, summarize, and document the reported bioactivities of *C. hadiensis*. This minireview will be an advantageous for future bioactivities and phytochemistry related researches of *C. hadiensis*.

Suitable published works were obtained employing the Web of Science, Scopus, PubMed, Semantic Scholar, and ScienceDirect databases from 1900 to December 2020. “*Coleus hadiensis*”, “*Plectranthus hadiensis*”, and “*Plectranthus zatarhendi* var. tomentosus” were used as search terms and the subjects were narrowed down to Biology, Chemistry, Medicine, Agriculture, Pharmacology, Pharmaceutics, Toxicology, Biochemistry, Genetics, Molecular Biology, and Multidisciplinary.
2. Reported Bioactivities of \textit{C. hadiensis}

Reported bioactivities of \textit{C. hadiensis} have been listed on Table 1. Hitherto, \textit{in vitro} level of scientific evidence is the highest level of scientific evidence available for the bioactivities of this plant species. Various parts of \textit{C. hadiensis} exhibited antioxidant, antibacterial, anti-inflammatory, anticancer, and antimalarial activities in a range of assays (Van Zyl et al., 2008; Mothana et al., 2010; Menon et al., 2010; 2011; 2012; 2014; Menon and Gopalakrishnan, 2015; Sripathi and Ravi, 2017; Rijo et al., 2018; Sripathi et al., 2018; Ji et al., 2019). A larger number of studies reported the antioxidant activities of this plant species and the aerial part and ethanol extracts were used in the majority of the investigations. To date, eight bioactive compounds (ayanin, casticin, chrysosplenol D, luteolin 7-O-glucuronide, quercetin 3, 7-dimethyl ether, rosmarinic acid, abietane diterpene 1, and 2) have been isolated from \textit{C. hadiensis}. Reported anti-inflammatory, anticancer, and antibacterial activities provide scientific evidence for the ethnomedicinal uses such skin disorders, inflammations, coughs, and carcinoma. Anyway, ethnomedicinal uses to treat illnesses like diarrhea, digestive disorders, and diabetes have no scientific evidence. Noteworthy investigations (based on the minor concentrations used) are only deliberated beneath.
**Table 1.** Reported *in vitro* bioactivities of *C. hadiensis*

| Bioactivity   | Part used | Extract compound | Assay                                      | Dose concentration | Reference              |
|---------------|-----------|------------------|--------------------------------------------|--------------------|------------------------|
| Antibacterial | Aerial    | Essential oil    | Escherichia coli, *Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus mutans* | 32 mg/dl (MIC)     | Sripathi et al., 2018 |
| Antibacterial | Leaf      | Aqueous, Methanol| Bacillus subtilis, Micrococcus flavus, Staphylococcus aureus, Staphylococcus aureus (ATCC 6538), Staphylococcus epidermidis | 4 mg               | Mothana et al., 2010  |
|               | Root      | Aqueous          | Staphylococcus aureus (ATCC 6538), Staphylococcus epidermidis, Staphylococcus haemolyticus | 4 mg               |                        |
|               | Root      | Methanol         | Bacillus subtilis, Micrococcus flavus, Staphylococcus aureus, Staphylococcus aureus (ATCC 6538), Staphylococcus epidermidis, Staphylococcus haemolyticus | 4 mg               |                        |
| Antibacterial | Seed      | Essential oil    | Escherichia coli, *Pseudomonas aeruginosa, Staphylococcus aureus* | NS                 | Sripathi and Ravi, 2017 |
| Antibacterial | Whole plant | Acetone       | *Bacillus subtilis* | 1 mg/ml | Rijo et al., 2018 |
| Anticancer    | Stem      | Methanol        | Cervical cancer (HeLa) cell line | 141.3 µg/ml (IC₅₀) | Menon et al., 2011 |
| Anticancer    | Aerial    | NS              | Human colon cancer cell (HCT-15) | 17.27 µg/ml | Menon and Gopalakrishnan, 2015 |
| Anti-inflammatory | Stem     | Methanol        | Bovine Serum Albumin denaturation inhibitory, Human red blood cell membrane stabilization, Platelet aggregation inhibitory | 1 mg/ml | Menon et al., 2011 |
| Anti-inflammatory | Aerial   | Ethanol (80%)  | Bovine Serum Albumin denaturation inhibitory, Human red blood cell membrane stabilization | 56.18 µg/ml (IC₅₀) | Menon et al., 2014 |
|               | Aerial    | Ethanol (80%)   | Human red blood cell membrane stabilization | 250 µg/ml | Menon et al., 2014 |
|               | Aerial    | Ethanol (80%)   | NO radical scavenging | 79.84 µg/ml (IC₅₀) | Menon et al., 2014 |
|               | Aerial    | Ethanol (80%)   | Platelet aggregation inhibitory | 54.26 µg/ml (IC₅₀) | Menon et al., 2014 |
|               | Aerial    | Ethanol (80%)   | Potassium ferricyanide reduction | 50 µg/ml | Menon et al., 2014 |
| Antimalarial  | Leaf      | NS (Abietane diterpene 1) | *Plasmodium falciparum* | 4.6 µM (IC₅₀) | Van Zyl et al., 2008 |
|               | Leaf      | NS (Abietane diterpene 2) | *Plasmodium falciparum* | 29.2 µM (IC₅₀) | Van Zyl et al., 2008 |
| Antioxidant   | Leaf      | Aqueous         | DPPH radical scavenging | > 1000 µg/ml (IC₅₀) | Mothana et al., 2010 |
|               | Root      | Methanol        | DPPH radical scavenging | 150 µg/ml (IC₅₀) | Mothana et al., 2010 |
|               | Root      | Methanol        | DPPH radical scavenging | > 1000 µg/ml (IC₅₀) | Mothana et al., 2010 |
| Bioactivity  | Part used | Extract compound          | Assay                      | Dose concentration          | Reference         |
|-------------|-----------|---------------------------|----------------------------|----------------------------|-------------------|
| Antioxidant | Aerial    | Ethanol (80%)             | DPPH radical scavenging    | 22.76 µg/ml (IC<sub>50</sub>) | Menon et al., 2014 |
| Antioxidant | Aerial    | Ayanin, Casticin          | DPPH radical scavenging    | > 100 µM (EC<sub>50</sub>)  |                   |
| Antioxidant | Aerial    | Ayanin                   | TBARS                      | 53.7 µM (IC<sub>50</sub>)   |                   |
| Antioxidant | Aerial    | Casticin                 | TBARS                      | 22.8 µM (IC<sub>50</sub>)   |                   |
| Antioxidant | Aerial    | Chrysosplenol D          | DPPH radical scavenging    | 48.3 µM (EC<sub>50</sub>)   |                   |
| Antioxidant | Aerial    | Chrysosplenol D          | TBARS                      | 2.5 µM (IC<sub>50</sub>)    |                   |
| Antioxidant | Aerial    | Ethanol (95%)            | DPPH radical scavenging,   | 20 µg/ml                    |                   |
| Antioxidant | Aerial    | Luteolin 7-O-glucuronide | DPPH radical scavenging    | 26.2 µM (EC<sub>50</sub>)   |                   |
| Antioxidant | Aerial    | Luteolin 7-O-glucuronide | TBARS                      | 2.8 µM (IC<sub>50</sub>)    |                   |
| Antioxidant | Aerial    | Quercetin 3, 7-dimethyl ether | DPPH radical scavenging | 31.2 µM (EC<sub>50</sub>)   | Ji et al., 2019   |
| Antioxidant | Aerial    | Quercetin 3, 7-dimethyl ether | TBARS                      | 3.8 µM (IC<sub>50</sub>)    |                   |
| Antioxidant | Aerial    | Rosmarinic acid          | DPPH radical scavenging    | 19 µM (EC<sub>50</sub>)     |                   |
| Antioxidant | Leaf      | Ethanol (30%, 50%, 70%, 95%) | DPPH radical scavenging | 100 µg/ml                   |                   |
| Antioxidant | Leaf      | Ethanol (50%, 70%, 95%)   | TBARS                      | 5 µg/ml                     |                   |
| Antioxidant | Stem      | Ethanol (30%, 50%, 70%, 95%) | DPPH radical scavenging | 100 µg/ml                   |                   |
| Antioxidant | Stem      | Ethanol (50%, 70%, 95%)   | TBARS                      | 5 µg/ml                     |                   |
| Antioxidant | Aerial    | Methanol                 | DPPH radical scavenging,   | 100 µg/ml                   | Menon et al.,      |
| Antioxidant | Aerial    | Methanol                 | FRAP                       |                             | 2012              |
| Antioxidant | Whole plant | Acetone, Aqueous          | TLC-DPPH bleaching         | 1 mg/ml                     | Rijo et al., 2018 |

DPPH: 2,2-diphenyl-1-picrylhydrazyl; NS: Not stated; TBARS: Thiobarbituric acid reactive substance; IC<sub>50</sub>: Half maximal inhibitory concentration; EC<sub>50</sub>: Half maximal effective concentration; MIC: Minimum Inhibitory Concentration; NO: Nitric oxide; FRAP: Ferric reducing antioxidant power; TLC: Thin-Layer Chromatography
2.1. Antibacterial activity

Acetone extract prepared used the whole of showed antibacterial activity at 1 mg/ml concentration in Bacillus subtilis assay (Rijo et al., 2018).

2.2. Anticancer activity

Menon and Gopalakrishnan (2015) reported that aerial extract (17.27 µg/ml) showed anticancer activity human colon cancer cell (HCT-15) line (Menon and Gopalakrishnan, 2015). Anyway, the authors did not mention the solvent used to prepare the extract.

2.3. Anti-inflammatory Activity

Aerial ethanol (80%) extract showed anti-inflammatory effects in potassium ferricyanide reduction assay at a concentration of 50 µg/ml (Menon et al., 2014).

2.4. Antimalarial Activity

So far, two antimalarial compounds have been identified from leaves this plant species. Abietane diterpene 1 and 2 revealed antimalarial properties in Plasmodium falciparum assay at IC50 of 4.6 µM and 29.2 µM respectively (Van Zyl et al., 2008).

2.5. Antioxidant activity

Antioxidant compounds including ayanin, casticin, rosmarinic acid, chrysosplenol D, luteolin 7-O-glucuronide, and quercetin 3,7-dimethyl ether have been discovered in C. hadiensis (Ji et al., 2019). Among these compounds, rosmarinic acid isolated from aerial part unveiled antioxidant effects in thiobarbituric acid reactive substance assay at IC50 1.5 µM.

3. Conclusion

Published bioactivities related articles involving C. hadiensis parts provide some scientific evidence for its ethnomedicinal uses. Still, some other ethnomedicinal uses have no scientific evidence. Thus, more bioactivities related studies should be conducted and active compounds
should be isolated. Then these compounds should be studied further in *in vitro, in vivo*, and clinical trial studies. Further, toxicity studies of various extracts and isolated bioactive compounds should be conducted for safety and efficacy determinations. As this plant species exhibited several bioactivities in various *in vitro* assays only, these bioactivities should be further studied in suitable *in vivo* models. These studies would provide new drugs for killer diseases like cancer in the future. This minireview analyzed, summarized, and documented the reported bioactivities of *C. hadiensis*. In addition, this minireview provides a basis for further bioactivities researches using *C. hadiensis* in future.

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**References**

Ji, H-S., Li, H., Mo, E-J., Kim, U-H., Kim, Y-H., Park, H-Y., Jeong, T-S. 2019. Low-density lipoprotein-antioxidant flavonoids and a phenolic ester from *Plectranthus hadiensis* var. *tomentosus*, Applied Biological Chemistry, 62(1): 58.

Kew Science, *Coleus hadiensis* (Forssk.) A.J.Paton. Plants of the World Online, http://plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:77201104-1, (December 2020).

Lukhoba, C.W., Simmonds, M.S.J., Paton, A.J. 2006. *Plectranthus*: A review of ethnomedical uses, Journal of Ethnopharmacology, 103(1): 1-24.

Menon, D.B., Sasikumar, J.M., Latha, K. 2011. Anti-inflammatory and cytotoxic activity of methanolic extract of *Plectranthus hadiensis* Stem, Pharmacologyonline, 3:275-282.

Menon, D.B., Sasikumar, J.M., Latha, K. 2012. Phytochemical analysis and antioxidant activity of methanolic extract of *Plectranthus hadiensis* (Forssk.) Schweinf. ex Spreng. aerial parts, Indian Journal of Natural Products and Resources, 3(3): 359-65.

Menon, D.B., Sasikumar, J.M., Gopalakrishnan V.K. 2014. Antioxidant and anti-inflammatory properties of terpenoid fraction isolated from the shoot of *Plectranthus hadiensis*, International Journal of Pharma and Bio Sciences, 5(2): B197-205.

Menon, D.B., Gopalakrishnan, V.K. 2015. Terpenoids isolated from the shoot of *Plectranthus hadiensis* induces apoptosis in human colon cancer cells via the mitochondria-dependent pathway, Nutrition and Cancer, 67(4): 697-705.

Mothana, R.A.A., Abdo, S.A.A., Hasson, S., Althawab, F.M.N., Alaghbari, S.A.Z. et al. 2010. Antimicrobial, antioxidant and cytotoxic activities and phytochemical screening of some yemeni medicinal plants, Evidence-Based Complementary and Alternative Medicine, 7(3): 323-330.

Rice, L.J., Brits, G.J., Potgieter, C.J., Staden, J.V. et al. 2011. *Plectranthus*: a plant for the future?, South African Journal of Botany, 77(4): 947-959.
Rijo, P., Mariana, B., Marisa, M., Helga, R., Sandra, J. et al. 2018. Screening of antioxidant and antimicrobial activities on *Plectranthus* spp. extracts, Journal Biomedical and Biopharmaceutical Research, 9(2): 225-235.

Sathasivampillai, S.V., Rajamanoharan, P.R., Munday, M., Heinrich, M. et al. 2015. Preparations and plants used to treat diabetes in Sri Lankan siddha medicine. In: Colombo: Institute of Indigenous Medicine, University of Colombo.

Sathasivampillai, S.V., Rajamanoharan, P.R., Munday, M., Heinrich, M. et al. 2017. Plants used to treat diabetes in Sri Lankan siddha medicine – An ethnopharmacological review of historical and modern sources, Journal of Ethnopharmacology, 198: 531-599.

Sathasivampillai, S.V., Rajamanoharan, P.R., Munday, M., Heinrich, M. et al. 2018. Siddha medicine in eastern Sri Lanka today–continuity and change in the treatment of diabetes, Frontiers in Pharmacology, 9.

South African National Biodiversity Institute, http://pza.sanbi.org/coleus-hadiensis, (December 2020).

Sripathi, R., Dharani, J., Subban, R. 2018. A study on the seasonal variation of the essential oil composition from *Plectranthus hadiensis* and its antibacterial activity, Natural Product Research, 32(7): 871-874.

Sripathi, R., Subban, R. 2017. Chemical composition and antibacterial activity of the essential oil from the seeds of *Plectranthus hadiensis*, International Journal of Pharmacognosy and Phytochemical Research, 9(5): 637–639.

Van Zyl, R.L., Khan, F., Edwards, T.J., Drewes, S.E. 2008. Antiplasmodial activities of some abietane diterpenes from the leaves of five *Plectranthus* Species, South African Journal of Science, 104(1–2): 62–64.