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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.

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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-cubebene, 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.

Figure 1. *Coleus hadiensis* (Forssk.) A. J. Paton (http://pza.sanbi.org/coleus-hadiensis)

2. Reported Bioactivities of C. hadiensis

Reported bioactivities of *C. hadiensis* have been listed on Table 1. 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 (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 *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*, *Streptococcus mutans*	32 mg/dl (MIC)	Sripathi et al., 2018
Antibacterial	Leaf	Aqueous, Methanol	*Bacillus subtilis*, *Micrococus 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*, *Micrococus 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 (IC_{50})	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	56.18 µg/ml (IC_{50})	Menon et al., 2014
	Aerial	Ethanol (80%)	Human red blood cell membrane stabilization	250 µg/ml	
	Aerial	Ethanol (80%)	NO radical scavenging	79.84 µg/ml (IC_{50})	
	Aerial	Ethanol (80%)	Platelet aggregation inhibitory	54.26 µg/ml (IC_{50})	
	Aerial	Ethanol (80%)	Potassium ferricyanide reduction	50 µg/ml	
Antimalarial	Leaf	NS (Abietane diterpene 1)	*Plasmodium falciparum*	4.6 µM (IC_{50})	Van Zyl et al., 2008
	Leaf	NS (Abietane diterpene 2)	*Plasmodium falciparum*	29.2 µM (IC_{50})	
Antioxidant	Leaf, Root	Aqueous	DPPH radical scavenging	> 1000 µg/ml (IC_{50})	Mothana et al., 2010
	Leaf	Methanol	DPPH radical scavenging	150 µg/ml (IC_{50})	
	Root	Methanol	DPPH radical scavenging	> 1000 µg/ml (IC_{50})	

Bioactivity	Part used	Extract compound	Assay	Dose concentration	Reference
Antioxidant	Aerial	Ethanol (80%)	DPPH radical scavenging	22.76 µg/ml (IC_{50})	Menon et al., 2014
Antioxidant	Aerial	Ayanin, Casticin	DPPH radical scavenging	> 100 µM (EC_{50})	Ji et al., 2019
	Aerial	Ayanin	TBARS	53.7 µM (IC_{50})	
	Aerial	Casticin	TBARS	22.8 µM (IC_{50})	
	Aerial	Chrysosplenol D	DPPH radical scavenging	48.3 µM (EC_{50})	
	Aerial	Chrysosplenol D	TBARS	2.5 µM (IC_{50})	
	Aerial	Ethanol (95%)	DPPH radical scavenging, TBARS	20 µg/ml	
	Aerial	Luteolin 7-O-glucuronide	DPPH radical scavenging	26.2 µM (EC_{50})	
	Aerial	Luteolin 7-O-glucuronide	TBARS	2.8 µM (IC_{50})	
	Aerial	Quercetin 3, 7-dimethyl ether	DPPH radical scavenging	31.2 µM (EC_{50})	
	Aerial	Quercetin 3, 7-dimethyl ether	TBARS	3.8 µM (IC_{50})	
	Aerial	Rosmarinic acid	DPPH radical scavenging	19 µM (EC_{50})	
	Aerial	Rosmarinic acid	TBARS	1.5 µM (IC_{50})	
	Leaf	Ethanol (30%, 50%, 70%, 95%)	DPPH radical scavenging	100 µg/ml	
	Leaf	Ethanol (50%, 70%, 95%)	TBARS	5 µg/ml	
	Stem	Ethanol (30%, 50%, 70%, 95%)	DPPH radical scavenging	100 µg/ml	
	Stem	Ethanol (50%, 70%, 95%)	TBARS	5 µg/ml	
Antioxidant	Aerial	Methanol	DPPH radical scavenging, FRAP	100 µg/ml	Menon et al., 2012
	Aerial	Methanol	NO radical scavenging	1 mg/ml	
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_{50}: Half maximal inhibitory concentration; EC_{50}: 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 IC_{50} 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 IC_{50} 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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