

# Antioxidant and Free Radical Scavenging Activity Comparison in Various Plant Parts of *Justicia adhatoda* L.

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## Abstract

There are many medicinal plants that have various medicinal properties in their different parts. Medicinal plants are the major backbone of pharmaceutical industries. In this article, we compare the antioxidant properties of various plant parts (root, stem, leaf, flower, and bark) of the most important medicinal plant, *Justicia adhatoda* L. various plant parts showed a good amount of antioxidant properties. These results enhance the medicinal properties of this plant due to the presence of the good content of antioxidants; among all the plant parts leaves and flowers showed maximum natural antioxidants, hence the study could be saying that this plant has good efficacy of antioxidants.

**Keywords:** Antioxidants • Medicinal plant • *Justicia adhatoda* L. • Antioxidant properties • Free radicals

## Introduction

Plants utilization as medicine is very common in tribal areas where people use different types of plants for their alternative medicine. As the cost of these medicinal plants is much cheaper than that of those artificial medicines and there are no side effects in using these medicinal plants. Humans are using plants as medicine not only for their own treatment of various ailments but also use for domestic animals too. Active compounds that are produced during secondary metabolism are usually responsible for the medicinal properties of the medicinal plants that are used throughout the world for various purposes, including the treatment of various infectious diseases [1]. There are about 2000 ethnic groups in the world, and almost every group has its own unique traditional medicinal knowledge and experience [2]. The plants have shown strong antioxidant properties that prevent oxidative stress. Nose defined antioxidants as 'any substance, when present at low concentrations compared with that of an oxidizable substrate that significantly delays or prevents oxidation of the substrate'. Antioxidants are the essential substance that has power over the capacity to defend the body from reparation caused by complimentary fundamental induced oxidative stress [3]. Free radicals are continuously produced in the human body, as they are essential for energy supply, detoxification, chemical signaling, and immune function. Antioxidant compounds from plants, particularly polyphenols, can inhibit the propagation of free radical reactions and protect the human body from different diseases [4]. Increased levels of free radicals cause oxidative damage to biological macromolecules and disrupt the balance of cellular oxidation-reduction [5]. The free radicals act as toxic for the cellular system, and it increases the chance of being susceptible to the disease-causing pathogen [6].

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Antioxidants such as phenolic compounds can inhibit the propagation of free radical reactions and protect living being from different diseases [7]. Major sources of natural antioxidants are fruits, vegetables, grains, green, and black tea, coffee and herbs and spices [8]. The study done on medicinal plants strongly supports the idea that plant constituents with antioxidant activity are capable of exerting protective effects against oxidative stress in biological systems [9]. In this study, *Justicia adhatoda* L. was selected for the screening of antioxidants that belongs to the family Acanthaceae and is widely spread throughout the tropical region of south-east Asia, a common small evergreen, sub-herbaceous bush plant. In India, it is distributed throughout the country especially in the lower Himalaya up to 1300 meters above sea level. Botanically, leaves are simple, opposite, ovate-lanceolate, acute and shiny; flowers white, capsule shape. In Ayurveda this plant is known as the 'Vasaka' that is well known medicinal plant used by the tribal/indigenous people which is used in treatment of various ailments or disorders including; leprosy, blood disorders, heart troubles, fever, vomiting, jaundice, tumours, leucoderma, mouth troubles, cough, cold, whooping-cough, asthma, bronchitis, tuberculosis, sore eyes and gonorrhoea, antispasmodic, expectorant and blood-purifying qualities [10]. On the basis of its wide use of medicine our experimental work focused on comparative antioxidant activities of various plant parts such as flower, leaf, stem, bark and root.

## Materials and Methods

*Justicia adhatoda* L. was selected on the basis of availability, seasonality, multiple medicinal uses from the campus of BSI (Botanical Survey of India), Northern Regional Centre, Kaulagarh Road Dehradun, Uttarakhand. Plant tissues from different plant parts (flowers, leaves, bark, stem and roots) were homogenized in a chilled pestle and mortar. The homogenate was centrifuged at 12000 g for 20 min at 4°C. The resulting supernatant was used as crude enzyme extract. Various antioxidants such as Catalase (CAT), Peroxidase (PO), Polyphenol Oxidase (PPO), Malondialdehyde (MDA) and Ascorbic Acid (AA) were examined by using this enzyme extract. 2, 2'-Diphenyl Picryl Hydrazyl (DPPH) free radical scavenging activity and total phenolic contents were measured on the basis of standard curve with in various concentrations of DDPH methanolic solution and gallic acid equivalent respectively. Whole experiment was

done in laboratory conditions with three replicates (n=3) of each treatments statistical analysis of mean values  $\pm$  SE that were subjected to one factorial Analysis of Variance (ANOVA) [11].

## Results and Discussion

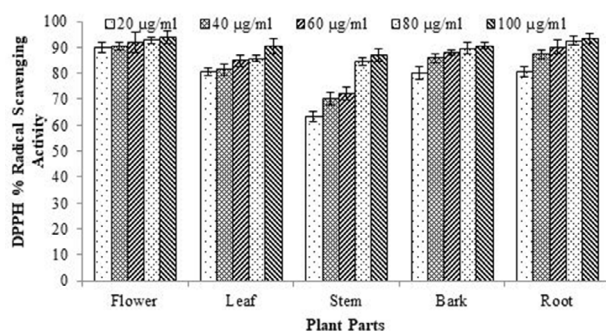
The antioxidants evaluated and comparatively analyzed from different plant parts of *Justicia adhatoda* L. Catalase (CAT), Peroxidase (PO) and Polyphenol Pxidase (PPO) that were measure in unit  $\text{mg}^{-1}$  fresh weight ( $\text{U mg}^{-1}$  fresh wt.); Melondialdehyde (MDA) and Ascorbic Acid (AA) were measured in  $\mu\text{g g}^{-1}$  fresh wt. which have been presented in Table 1. Maximum CAT activity ( $91.56 \pm 4.15$ ) recorded in leaves followed by flowers ( $45.23 \pm 3.11$ ) while least in roots ( $17.09 \pm 2.63$ ); similar as CAT, maximum and minimum PO recorded in leaves ( $1.87 \pm 0.61$ ) and roots

( $0.32 \pm 0.44$ ) respectively while bark showed second largest amount ( $1.03 \pm 0.51$ ) of PO. In the observation of PPO bark showed maximum ( $9.21 \pm 2.49$ ) followed by flowers ( $7.76 \pm 1.44$ ) and roots ( $5.22 \pm 1.61$ ) while leaves ( $1.04 \pm 0.87$ ) showed least amount of PPO activity. In MDA evaluation leaves have maximum activity ( $79.24 \pm 3.21$ ) while roots ( $48.56 \pm 2.18$ ) showed minimum; for AA measurements stem had maximum ( $2850 \pm 1.22$ ) followed by roots ( $2130 \pm 1.06$ ) and bark ( $1970 \pm 1.37$ ) along with least activity in flowers ( $230 \pm 1.56$ ). The total DPPH% free radical scavenging activity ranges from  $86.84 \pm 2.40$  to  $93.85 \pm 2.51$  ( $86.84 \pm 2.40$  (stem)  $< 90.36 \pm 2.83$  (leaves)  $< 90.64 \pm 1.44$  (bark)  $< 93.23 \pm 2.15$  (roots)  $< 93.85 \pm 2.51$  (flowers) (Figure 1). Similarly, the total phenolic content ( $\mu\text{g}/\text{mgGAE}$ ) range from  $29.51 \pm 2.88$  to  $69.83 \pm 1.34$  ( $29.51 \pm 2.88$  (stem)  $< 50.32 \pm 2.93$  (bark)  $< 59.22 \pm 1.47$  (roots)  $< 62.57 \pm 2.01$  (leaves)  $< 69.83 \pm 1.34$  (flowers) in various plant parts (Figure 2).

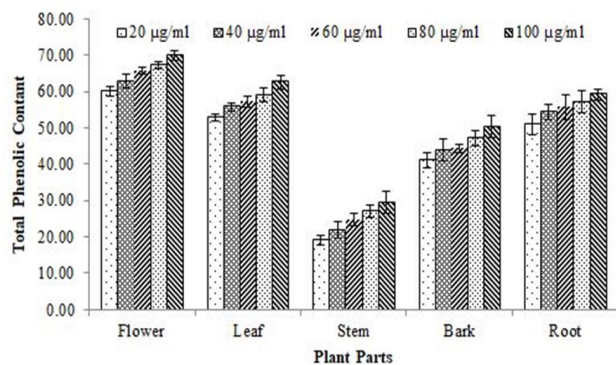
### Antioxidant enzymes

Plant Parts	Catalase (CAT) ( $\text{U mg}^{-1}$ fresh wt.)	Peroxidase (PO) ( $\text{U mg}^{-1}$ fresh wt.)	Polyphenol oxidase (PPO) ( $\text{U mg}^{-1}$ fresh wt.)	Malondialdehyde (MDA) ( $\mu\text{g g}^{-1}$ fresh wt.)	Ascorbic Acid (AA) ( $\mu\text{g g}^{-1}$ fresh wt.)
Flower	$45.23 \pm 3.11$	$0.68 \pm 0.24$	$7.76 \pm 1.44$	$62.11 \pm 2.59$	$230 \pm 1.56$
Leaf	$91.56 \pm 4.15$	$1.87 \pm 0.61$	$1.04 \pm 0.87$	$79.24 \pm 3.21$	$1550 \pm 0.99$
Stem	$32.11 \pm 2.02$	$0.49 \pm 0.35$	$3.72 \pm 0.43$	$65.33 \pm 0.66$	$2850 \pm 1.22$
Bark	$39.88 \pm 3.85$	$1.03 \pm 0.51$	$9.21 \pm 2.49$	$51.45 \pm 1.99$	$1970 \pm 1.37$
Root	$17.09 \pm 2.63$	$0.32 \pm 0.44$	$5.22 \pm 1.61$	$48.56 \pm 2.18$	$2130 \pm 1.06$

**Table 1.** The antioxidants evaluated and comparatively analyzed from different plant parts of *Justicia adhatoda* L. Catalase (CAT), Peroxidase (PO) and Polyphenol Pxidase (PPO) that were measure in unit  $\text{mg}^{-1}$  fresh weight ( $\text{U mg}^{-1}$  fresh wt.); Melondialdehyde (MDA) and Ascorbic Acid (AA) were measured in  $\mu\text{g g}^{-1}$  fresh wt.



**Figure 1.** DPPH% radical scavenging activity with various concentrations ( $\mu\text{g}/\text{ml}$ ) in various plant parts of *J. adhatoda*.



**Figure 2.** Total phenolic contents with various concentrations ( $\mu\text{g}/\text{ml}$ ) in various plant parts of *J. adhatoda*.

The plant showed strong antioxidant and reducing power ability. Antioxidant enzymes are defensive against oxidative stresses that have been studied extensively in higher plants [12]. CAT, the first reported antioxidant enzyme is the most universal oxidoreductase, which scavenges  $\text{H}_2\text{O}_2$  to  $\text{O}_2$  and  $\text{H}_2\text{O}$  that metabolize the peroxide [13]. PO is an oxidoreductase that is directly involved in the plant physiological functions such as hormone regulation, defence mechanisms, indolacetic degradation and lignin biosynthesis [14]. These properties of antioxidant found in every parts of plant that make them medicinally important similar to this current study in which each plant parts shows good efficacy of antioxidants [15]. The medicinal properties of plants generally due to the presence of secondary metabolites as alkaloids, phenols, tannin etc. which are present in various plant parts. Phenolic compounds have redox properties that can impart antioxidant properties to the plants where they act as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators [16]. The phenolic compounds are predominantly associated with antioxidant activities that scavenge free radicals which are generally produced in human body, in this scenario various *in vitro* models have been widely used to investigate antioxidants potential of plant materials [17]. The plant extracts generally rich in antioxidants and other essential phytoconstituents earlier presented in various antioxidant models [18]. The DPPH interactions with antioxidants neutralize the free radicals where antioxidants transfer electron or hydrogen atoms [19,20].

## Conclusion

Many earlier studies on the leaves and flowers of *Justicia adhatoda* L. were determined that are similar to this study. Nutshell, on the basis of current results each plant part could be medicinally important due to the presence of antioxidant; among all the plant parts leaves and flowers showed maximum natural antioxidants, hence the study could be saying that this plant has good efficacy of antioxidants.

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