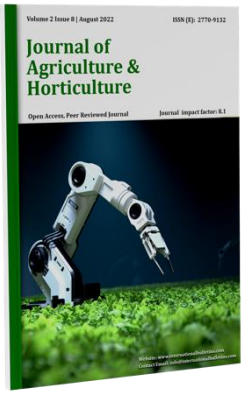


# EVALUATION OF BIOCHEMICAL ACTIVITY OF PLATYCLADUS ORIENTALIS (L.) FRANCO IN ECOLOGICAL CONDITIONS IN ROAD ATROPHY BASED ON PHYSICOCHEMICAL METHODS

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**Abstract:** This study is devoted to the evaluation of the biochemical composition of alcoholic (ethanolic) and chloroform extracts obtained from *Platycladus orientalis* (L.) Franco growing in roadside areas and environmentally clean zones, using physicochemical methods. The needles and young shoots of the plant were extracted with ethanol and chloroform, and the resulting extracts were analyzed by IR spectroscopy and chromatographic techniques. Chromatographic analysis confirmed that the alcoholic extracts were enriched mainly with polar biologically active compounds, whereas the chloroform extracts contained predominantly nonpolar and volatile constituents. The obtained results make it possible to assess differences in metabolic adaptation and the synthesis of biologically active substances in *Platycladus orientalis* under ecological stress conditions, and demonstrate the significance of this plant in ecological monitoring and phytochemical research.

**Keywords:** *Platycladus orientalis*, roadside ecology, environmentally clean area, alcoholic extract, chloroform extract, IR spectroscopy, chromatography, phenolic compounds, flavonoids, terpenoids, biological activity, ecological stress.

## Introduction

In recent years, the rapid increase in the number of motor vehicles has led to a deterioration of environmental conditions in urban and suburban areas. Pollutant emissions released into the atmosphere along roadsides—including exhaust gases, aerosol particles of heavy metals, dust, and other toxic components—have a direct impact on plant growth, development, and physiological–biochemical status. Therefore, investigating the responses of plants growing in roadside environments to ecological stress is of significant scientific and practical importance.

From this perspective, the evergreen coniferous tree *Platycladus orientalis* (L.) Franco deserves particular attention. This species is widely distributed in urban and roadside landscapes and is distinguished by its high adaptability and its ability to trap dust and harmful gases. The leaves of *Platycladus orientalis* are morphologically classified as scale-like leaves; their dense arrangement and well-developed waxy cuticle reduce transpiration and play an important protective role for the plant under conditions of ecological stress[1-24].

However, differences in the condition of scale-like leaves, biochemical composition, and biological activity of *Platycladus orientalis* growing in roadside areas compared with those in environmentally clean zones have not yet been studied in sufficient depth or in a comprehensive manner. In particular, analyzing the composition of alcoholic and chloroform extracts obtained from plants growing under different ecological conditions using physicochemical methods is crucial for elucidating stress-adaptation mechanisms.

The main objective of the present study is to carry out a comparative evaluation of the biochemical activity, the morphophysiological state of scale-like leaves, and the composition of biologically active compounds in *Platycladus orientalis* growing in roadside environments and environmentally clean areas, using physicochemical approaches. The results obtained are expected to substantiate the scientific and practical significance of this species for ecological monitoring, bioindication, and the stabilization of urban green spaces.

**Materials and Methods**

The study was conducted using samples of *Platycladus orientalis* (L.) Franco growing in roadside areas and environmentally clean zones. As experimental material, scale-like leaves and young shoots were collected from trees of the same age to ensure uniformity. Sampling was carried out during the active phase of the vegetation period under similar meteorological conditions. Roadside samples were collected from areas with high traffic intensity, whereas samples from environmentally clean sites were obtained from green zones free from industrial and transport impacts.

The collected plant materials were cleaned under laboratory conditions and dried in a shaded, well-ventilated room until a constant weight was achieved. The dried samples were then ground to a uniform particle size and prepared for extraction. Alcoholic extracts were obtained by treating the powdered plant material with 96% ethanol, while chloroform extracts were prepared using chloroform as the solvent. Extraction was performed in a Soxhlet apparatus for 4 hours. The resulting extracts were concentrated by removing the solvent under reduced pressure and stored in dark conditions until further analysis.

Infrared (IR) spectroscopy was used to determine the chemical composition of the extracts. Spectra were recorded in the range of 4000–400 $cm^{-1}$, and the absorption bands corresponding to functional groups were analyzed. For the qualitative separation and evaluation of biologically active compounds, thin-layer chromatography was employed.

The obtained data allowed for a comparative assessment of the biochemical activity of *Platycladus orientalis* samples collected from roadside environments and environmentally clean areas. All experiments were performed in triplicate, and the results were expressed as mean values.

**Results and Discussion**

The results of the conducted study demonstrate that *Platycladus orientalis* (L.) Franco growing in roadside areas and environmentally clean zones exhibits significant differences in biochemical activity, metabolic pathways, and protective–adaptive mechanisms. Infrared (IR) spectroscopic and chromatographic analyses of alcoholic and chloroform extracts made it possible to substantiate these differences qualitatively and, to some extent, quantitatively.

According to the IR spectroscopic results, the alcoholic extracts obtained from plants growing in roadside environments showed markedly higher intensities of absorption bands in the 3200–3600 $cm^{-1}$ region, corresponding to –OH functional groups, compared to samples from environmentally clean areas. This finding indicates an increased content of phenolic compounds and flavonoids. In addition, enhanced absorption bands in the 1650–1720 $cm^{-1}$ range, assigned to C=O functional groups, suggest an increased concentration of phenolic acids and other carbonyl-containing compounds. These substances are key components of the antioxidant defense system in plants, and their enhanced synthesis can be interpreted as an adaptive response to oxidative stress induced by vehicle emissions.

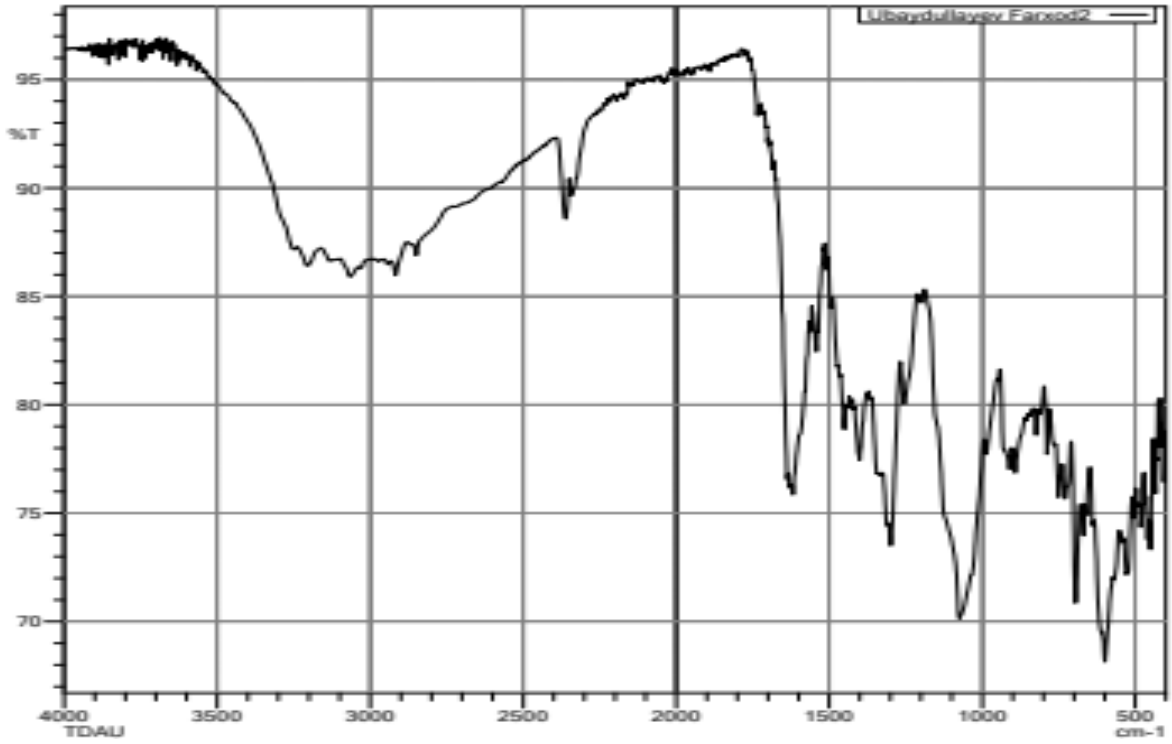
In contrast, the alcoholic extracts from environmentally clean sites displayed relatively stable and moderate absorption intensities, reflecting balanced metabolic processes. This suggests that under conditions of reduced external stress, the plant's defense system does not become excessively activated.

Analysis of the IR spectra of chloroform extracts revealed an increased synthesis of lipophilic components in plants growing near roadsides. The IR spectrum of the chloroform extract of *Platycladus orientalis* (L.) Franco indicates a predominance of nonpolar, lipophilic biologically active compounds. Strong absorption bands observed in the 2950–2850 $cm^{-1}$ region correspond to the stretching vibrations of aliphatic C–H bonds (–$CH_3$ and –$CH_2$–), confirming the presence of terpenoids, essential oils, and hydrocarbon-type compounds. This observation is fully consistent with the ability of chloroform to efficiently extract lipophilic substances.

Absorption bands recorded in the 1700–1650 $cm^{-1}$ range are characteristic of carbonyl (C=O) groups, indicating the presence of ketones, aldehydes, or esters. These compounds are commonly found in terpenoids and essential oils and play an important role in plant defense and adaptation processes. Signals observed in the 1600–1500 $cm^{-1}$ region correspond to aromatic ring vibrations or conjugated C=C bonds, suggesting the presence of aromatic or isoprenoid-structured components in the extract.

The absorption bands in the 1450–1370 $cm^{-1}$ region are associated with deformation vibrations of –$CH_2$ and –$CH_3$ groups, further confirming the predominance of aliphatic chains. Absorptions detected in the 1200–1000 $cm^{-1}$ range correspond to C–O bonds, indicating the presence of alcohols, ethers, and esters. Low-frequency bands observed in the 900–700 $cm^{-1}$ region are characteristic of out-of-plane vibrations of aromatic rings and complex skeletal structures.

Overall, IR spectral analysis demonstrates that the chloroform extract of *Platycladus orientalis* is rich in terpenoids, essential oils, and other lipophilic biologically active compounds. These substances are likely to play an important role in the plant's adaptation to ecological stress and in the functioning of its protective mechanisms.




**The chromatographic analysis results also confirmed the data obtained by IR spectroscopy.**

On thin-layer chromatography (TLC) plates, several well-defined spots characteristic of polar biologically active compounds were observed in the alcoholic extracts. In samples collected from roadside areas, both the number of spots and their color intensity were higher, indicating a greater accumulation of biologically active substances. In contrast, the chloroform extracts were dominated by spots corresponding to nonpolar and volatile compounds. Samples obtained from environmentally clean areas exhibited fewer spots with relatively lower intensity, reflecting the stability and balance of metabolic processes under reduced stress conditions.

The overall analysis of the obtained results indicates that the biochemical activity of *Platycladus orientalis* is significantly enhanced under roadside environmental conditions. This enhancement reflects the activation of the plant's adaptive mechanisms to ecological stress through increased synthesis of phenolic compounds, flavonoids, and terpenoids. At the same time, the morphological and chemical characteristics of the scale-like leaves further confirm the importance of this species as a bioindicator. The findings suggest that *Platycladus orientalis* can be considered a promising plant species for roadside ecological monitoring, urban green space planning, and phytoremediation studies.

**Conclusion**

The results of the conducted study demonstrate that *Platycladus orientalis* (L.) Franco growing in roadside areas and environmentally clean zones exhibits significant differences in biochemical activity, metabolic pathways, and mechanisms of adaptation to ecological stress. IR spectroscopy and chromatographic analyses of alcoholic and chloroform extracts reliably confirmed these differences.

It was found that plants growing under roadside conditions show higher synthesis of phenolic compounds, flavonoids, and other antioxidant components compared with samples

from environmentally clean areas. This phenomenon can be interpreted as an adaptive response of the plant to oxidative stress caused by vehicle emissions, dust, and other anthropogenic factors. The increased content of terpenoids and other lipophilic compounds detected in the chloroform extracts indicates the strengthening of the protective layer on the surface of scale-like leaves, which limits the penetration of harmful external substances into plant tissues.

Furthermore, the morphophysiological state of the scale-like leaves and their chemical composition confirm that *Platycladus orientalis* possesses clear bioindicator properties. The enhancement of biochemical activity under roadside conditions may serve as an important diagnostic criterion for assessing environmental quality.

Overall, the obtained results suggest that *Platycladus orientalis* can be recommended as a promising plant species for establishing green protective zones along highways, as well as for use in ecological monitoring and phytoremediation processes. The data obtained provide a scientific basis for further in-depth studies of biologically active compounds of this species and their potential application in practical fields.

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