
# DIOSPYROS KAKI L. — CHEMICAL COMPOSITION OF ORIENTAL PERSIMMON LEAVES

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**Abstract.** This article examines the chemical composition of the leaves of *Diospyros kaki* L. — Oriental persimmon, cultivar “Hyakume”, cultivated in the Republic of Uzbekistan, with particular emphasis on phenolic and flavonoid compounds. Chloroform, ethanol, and ethyl acetate were used to extract biologically active compounds from the plant material. Each stage of the extraction process was repeated three times. The total polyphenol content of the obtained extracts was determined, and qualitative and quantitative analyses of the ethyl acetate fraction were performed using high-performance liquid chromatography (HPLC). According to the study results, the total polyphenol content in *D. kaki* leaves was 1.33% of the dry plant mass. HPLC analysis revealed the presence of dihydroquercetin, luteolin, quercetin, rutin, sineroside, apigenin, and salidroside in the ethyl acetate fraction. Their contents were 2.13, 1.12, 0.58, 36.18, 0.572, 4.50, and 1.50 mg/g, respectively. Among the identified compounds, the high content of rutin is of particular interest, indicating that it is one of the major identified flavonoid components of the studied fraction. The obtained results demonstrate the significance of *D. kaki* leaves as plant material rich in phenolic compounds and support their consideration as an important object for further phytochemical studies.

**Keywords:** *Diospyros kaki* L., Oriental persimmon, persimmon leaves, phenolic compounds, polyphenols, flavonoids, rutin, apigenin, quercetin, luteolin, HPLC.

**Introduction.** Fruits and vegetables are important components of the human diet and play a significant role in maintaining normal physiological functions of the body. Their nutritional value is determined not only by the presence of proteins, carbohydrates, vitamins, and minerals, but also by a variety of biologically active compounds. In particular, phenolic compounds, flavonoids, carotenoids, and other secondary metabolites found in plants have attracted considerable research interest due to their diverse biological properties [1]. Phenolic compounds are among the most widespread groups of secondary metabolites in plants. They play important roles in plant growth and development, adaptation to environmental factors, and protection of cells against oxidative damage. The composition and content of these compounds may vary considerably depending on the plant species and cultivar, vegetation period, growing conditions, and geographical origin [1,2]. Flavonoids constitute an important group of phenolic compounds and are mainly found in plants in the form of free aglycones or glycosides. Compounds such as quercetin, rutin, apigenin, and luteolin have been identified in the leaves, fruits, flowers, and other organs of various plant species. Determining their content in plant materials is an important indicator for assessing their chemical composition [2]. One of the promising plants in this regard is Oriental persimmon (*Diospyros kaki* L.). This species belongs to the family Ebenaceae and is widely cultivated primarily in East Asian countries such as China, Japan, and Korea. Currently, persimmon trees are also cultivated in other warm and

subtropical regions of the world, including the climatic conditions of Uzbekistan [3]. Several species belonging to the genus *Diospyros* are considered important both as food crops and for practical applications. Among them, species such as *Diospyros kaki*, *Diospyros virginiana*, *Diospyros lotus*, and *Diospyros oleifera* are of particular importance. Of these, *D. kaki*, or Oriental persimmon, is one of the most extensively studied species due to the nutritional value of its fruit and the diversity of biologically active compounds found in various parts of the plant [3,4]. Persimmon fruit is rich in carbohydrates and contains glucose and fructose. Ripe fruits contain ascorbic acid, minerals, and other biologically active components. The astringent taste of persimmon is mainly associated with soluble tannins and other polyphenolic compounds present in the fruit [3,5]. However, the biological value of *D. kaki* is not limited to its fruit. Recent studies have shown that persimmon leaves also contain various biologically active substances, particularly polyphenolic compounds. Flavonoids, phenolic acids, triterpenoids, and other natural compounds have been isolated from persimmon leaves [4,6]. In particular, chromatographic and mass spectrometric studies of the chemical composition of *D. kaki* leaves have identified numerous phenolic compounds. Researchers have reported the presence of quercetin derivatives, flavones, flavonols, and other phenolic metabolites in persimmon leaves [6,7]. The phenolic composition of persimmon leaves provides a basis for investigating them as a promising plant material for use in the pharmaceutical, food technology, and nutraceutical fields. However, the chemical composition of the plant may vary depending on its cultivar and growing conditions. Therefore, studying the chemical composition of persimmon cultivars grown in specific regions is of considerable scientific importance [3,6]. In this regard, the leaves of the astringent-fruited *Diospyros kaki* L. cultivar “Hyakume”, cultivated in the Republic of Uzbekistan, were selected as the object of the study.

Materials and methods. The leaves of the astringent-fruited *Diospyros kaki* L. — Oriental persimmon, cultivar “Hyakume”, cultivated in the Republic of Uzbekistan, were used as the study material. This cultivar was selected because it is cultivated under the conditions of the Republic and its leaves provide an opportunity to study biologically active compounds. Particular attention was paid to the identification of phenolic compounds in the plant leaves. Phenolic compounds are widely distributed among plant secondary metabolites, and their composition and content may vary depending on the plant species and cultivar, growing conditions, and methods used for processing the plant material [1,2].

**Extraction of phenolic compounds.** An extraction method was used to isolate phenolic compounds from *Diospyros kaki* leaves. Chloroform, ethanol, and ethyl acetate were used as solvents during the extraction process. Each stage of the extraction process was repeated three times. This approach helps to achieve the most complete possible extraction of biologically active compounds from the plant material and to improve the accuracy of the analytical results. The obtained extracts were separated into appropriate fractions for subsequent analysis. The use of solvents with different polarities during the extraction of phenolic compounds facilitates their fractionation according to their physicochemical properties. In the extraction of plant materials, the selection of a solvent based on its nature can directly affect the qualitative and quantitative composition of the resulting extract [3].

**Determination of total polyphenol content.** Following the extraction process, the total polyphenol content in *Diospyros kaki* leaves was determined. The results were expressed as a percentage relative to the dry mass of the plant material. The analysis showed that the total

polyphenol content in persimmon leaves was 1.33% per 100 g of dry plant material. This value indicates a considerable accumulation of polyphenolic compounds in the studied *D. kaki* leaves. However, it should be noted that the total polyphenol content does not represent the amount of individual compounds. The results of instrumental chromatographic analysis were used to determine the composition and content of individual components.

Identification of phenolic compounds using HPLC. Individual phenolic compounds in the ethyl acetate fraction obtained from persimmon leaves were analyzed using high-performance liquid chromatography (HPLC). The analysis was performed using reference standards. The compounds identified in the sample were characterized by comparison with the corresponding reference standards. The contents of the identified compounds were expressed in mg/g. The analysis revealed the presence of dihydroquercetin, luteolin, quercetin, rutin, sineroside, apigenin, and salidroside in the ethyl acetate fraction. HPLC is an effective analytical method for studying the multicomponent composition of plant materials and, through the use of reference standards, enables the identification and quantification of the components under investigation [4].

Results and discussion. The study of the chemical composition of the leaves of *Diospyros kaki* L. cultivar “Hyakume” showed that the total polyphenol content was 1.33% per 100 g of dry plant material. Using HPLC in the presence of reference standards, the presence and content of compounds belonging to the flavonoid class in the ethyl acetate fraction were determined (Table 1).

**Table 1.**

**Composition of polyphenols in persimmon leaves**

| **Flavonoids** | **Concentration, mg/g** |
|---|---|
| Dihydroquercetin | 2,13 |
| Luteolin | 1,12 |
| Quercetin | 0,58 |
| Rutin | 36,18 |
| Sineroside | 0,572 |
| Apigenin | 4,5 |
| Salidroside | 1,5 |

According to the results, rutin showed the highest content among the identified compounds. The identification of quercetin, luteolin, and apigenin also indicates the presence of various flavonoids in persimmon leaves. Salidroside was identified as a phenolic glycoside.

The literature indicates that *D. kaki* leaves contain quercetin derivatives, flavonoids, and other phenolic compounds [1,2]. The results of the present study also confirm that persimmon

leaves are rich in phenolic compounds. The obtained results are important for characterizing the chemical composition of the leaves of *D. kaki* L. cultivar "Hyakume" cultivated in Uzbekistan, particularly because the high content of rutin is of considerable interest for further research. The HPLC results indicate that *Diospyros kaki* leaves contain a high amount of rutin, while apigenin, dihydroquercetin, and salidroside are also present in appreciable amounts, opening up prospects for the future development of medicinal products and biologically active food supplements based on persimmon leaves.

**Conclusion.** The study investigated the phenolic composition of the leaves of *Diospyros kaki* L. cultivar "Hyakume" cultivated under the conditions of Uzbekistan. The analysis revealed the presence of total polyphenols, as well as various flavonoids and other phenolic compounds in the leaves. Among the components identified by HPLC, rutin was found to be predominant in terms of content. The obtained results demonstrate the significance of the leaves of *D. kaki* L. cultivar "Hyakume" as a source of phenolic compounds. The findings may serve as a basis for further investigation of the chemical composition of this plant material and the study of individual biologically active compounds.

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