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CHEMICAL COMPOSITION AND FOLK MEDICINAL SIGNIFICANCE OF THE BIDENS PLANT

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Annotation
This article provides information about the chemical composition, botanical characteristics, and the role of the Bidens plant in traditional medicine. The content of flavonoids in the dry extract of Bidens was determined using high-performance liquid chromatography (HPLC). Based on the results obtained, data are presented on the significance of phenolic compounds found in this plant for human health, as well as their effects against allergic skin diseases, diathesis, psoriasis, and microbes.

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Introduction. Medicinal plants have been known to humanity since ancient times. Plants have been widely used not only as food but also as sources of biologically active compounds. There is evidence that medicinal plants were used for therapeutic purposes as early as 5,000 years ago [1]. For many centuries, medicinal plants served as the sole source of therapeutic agents. One such plant with medicinal properties is Bidens tripartita.

Bidens tripartita L., commonly known among the people as “ittikanak” or “three-lobed beggarticks,” belongs to the Asteraceae family and is one of the annual plants with medicinal properties. Due to its morphological characteristics, ecological adaptability, and pharmacologically rich chemical composition, this plant holds an important place not only in traditional medicine but also in scientific medical practice [2].

Botanically, Bidens tripartita is an annual plant with an erect, often branched stem that is sometimes covered with hairs, and it can grow up to 15–100 cm tall. Its leaves are simple but usually divided into three lobes; the lobes are elongated-lanceolate with serrated edges and arranged oppositely on the stem. The flowers form a complex inflorescence (capitulum) and are yellow or pale yellow in color, with each capitulum consisting of many small flowers. These flowers are arranged in a head-like structure, with the outer flowers being ray florets and the central ones being tubular [3].

Bidens tripartita is widespread across almost all regions of Uzbekistan, including Andijan, Fergana, Tashkent, and Namangan provinces. The plant mainly grows in moist areas—along rivers, streams, irrigation canals, marshes, near reservoirs, rice fields, and meadows. It is also found as a weed in cultivated fields. Due to its ecological resilience, Bidens tripartita is well-adapted to various soil and climate conditions [4].

In terms of chemical composition, Bidens tripartita is considered a rich plant. It contains flavonoids (especially luteolin and its glycosides), polyphenols (up to approximately 3.55%), coumarins, polysaccharides (up to 3%), carotene (28.3–61.26 mg%), ascorbic acid (vitamin C — 748–953.3 mg%), as well as essential oils (0.16–0.18%), small amounts of alkaloids, bitter substances, and tannins [5]. All of these substances are pharmacologically active components, and their combination determines the plant's wide range of therapeutic effects.

Bidens tripartita has been used in folk medicine for centuries. Its infusions and decoctions are used to treat internal inflammations, colds, as a diuretic, and also as a hemostatic, diaphoretic, and appetite stimulant. For skin diseases such as diathesis, scabies, and eczema, it is recommended in the form of baths. In traditional medicine, the plant is also used as a supportive treatment for cancer and in the form of tea for diabetes [6].

In Eastern medicine, particularly in Tibet and China, preparations made from Bidens tripartita have been used to treat anemia, tuberculosis, atherosclerosis, and fever. In the alternative medicine practices of these regions, the plant has been proven through experience to have calming, immune-boosting, blood pressure-lowering, and pain-relieving effects [7].

In scientific medicine, Bidens tripartita is mainly recommended for the treatment of kidney and urinary tract diseases, as a remedy for colds and to induce sweating, and in some cases as an antiseptic and anti-inflammatory agent. The raw material of this plant is standardized in pharmacopoeias for use in the production of medicinal preparations [8].

Although the chemical composition of Bidens tripartita has been studied by several foreign and domestic researchers, the phenolic compounds and their quantity in plants growing in the Andijan region have not been studied. In our research, these compounds were identified using high-performance liquid chromatography (HPLC).

Experimental Section.

Reagents and Equipment Used: Gallic acid (Macklin, China), caffeine (Shimadzu, Kyoto, Japan), salicylic acid (Rhydburg Pharmaceuticals, Germany), rutin and quercetin were extracted from natural sources using column chromatography. HPLC-grade water, acetonitrile, glacial acetic acid, and sodium hydroxide of chemically pure grade were used.

The determination of water-soluble phenolic compounds and caffeine in the plant was performed on a Shimadzu LC-40 Nexera Lite high-performance liquid chromatograph (Japan).

Preparation of Standard Solutions:

Gallic acid (5 mg), salicylic acid (5.1 mg), rutin (5 mg), and quercetin (4.6 mg) were dissolved in methanol using an ultrasonic bath for 20 minutes and transferred into a 25 ml volumetric flask, then diluted to the mark with methanol. A 250 mg/L standard caffeine solution was prepared. 200 µl of each solution was mixed, and three diluted solutions were prepared by fivefold serial dilution. Each solution was poured into a vial for analysis.

Preparation of Plant Extract:

To extract phenolic compounds and caffeine, 1 g of the test sample was weighed to an accuracy of 0.01 g and placed in a 50 ml conical flask with 25 ml of 96% ethanol. The mixture was sonicated at 60°C for 20 minutes, then cooled, filtered, and diluted with ethanol to 25 ml in a volumetric flask. 1.5 ml of the extract was filtered through a 0.45 µm syringe filter into a vial for analysis.

Chromatographic Conditions

Flavonoid Identification:

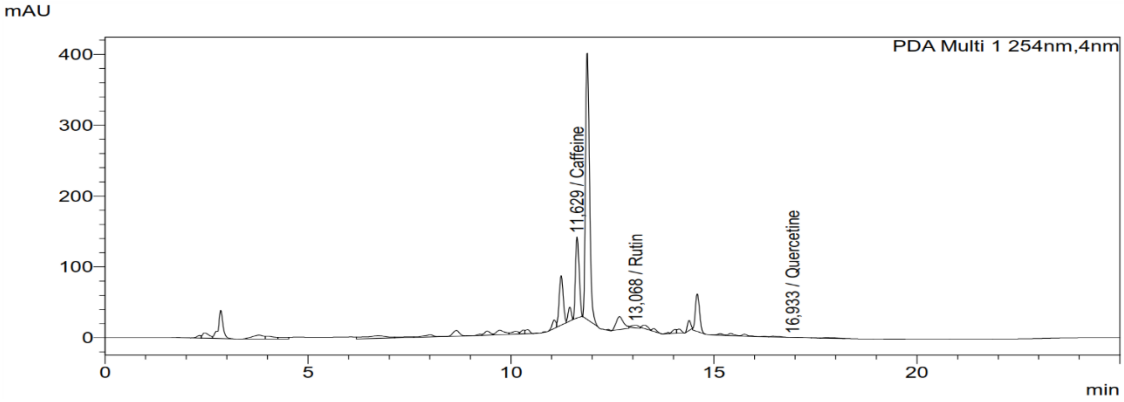
The standard solutions and sample extract were analyzed using the LC-40 Nexera Lite HPLC system comprising an LC-40D pump, SIL-40 autosampler, and SPD-M40 photodiode array (PDA) detector with LabSolutions version 6.92 software. A Shim-pack GIST C18 (150 × 4.6 mm; 5 µm, Shimadzu, Japan) reverse-phase column was used, with a gradient mobile phase consisting of acetonitrile (A) and 0.25% aqueous acetic acid solution (B), as shown in Table 1. The injection volume was 10 µl, the flow rate was 0.5 ml/min, and the column temperature was set at 40°C. Analytical signals of phenolic compounds (peak areas) were recorded at 234 and 254 nm

Gradient Program for Mobile Phase

Time	Atsetonitril (A), %	0,5 % li sirka acid (B), %
0	10	90
2	10	90
12	50	50
14	50	50
18	10	90
25	Ending	

Results obtained.

Determining the amount of phenol compounds and coffeehe content of itzalak extract. The chromomatogram of the sample extract with average mass was obtained (Figure 3) and the results were processed in Table 2.



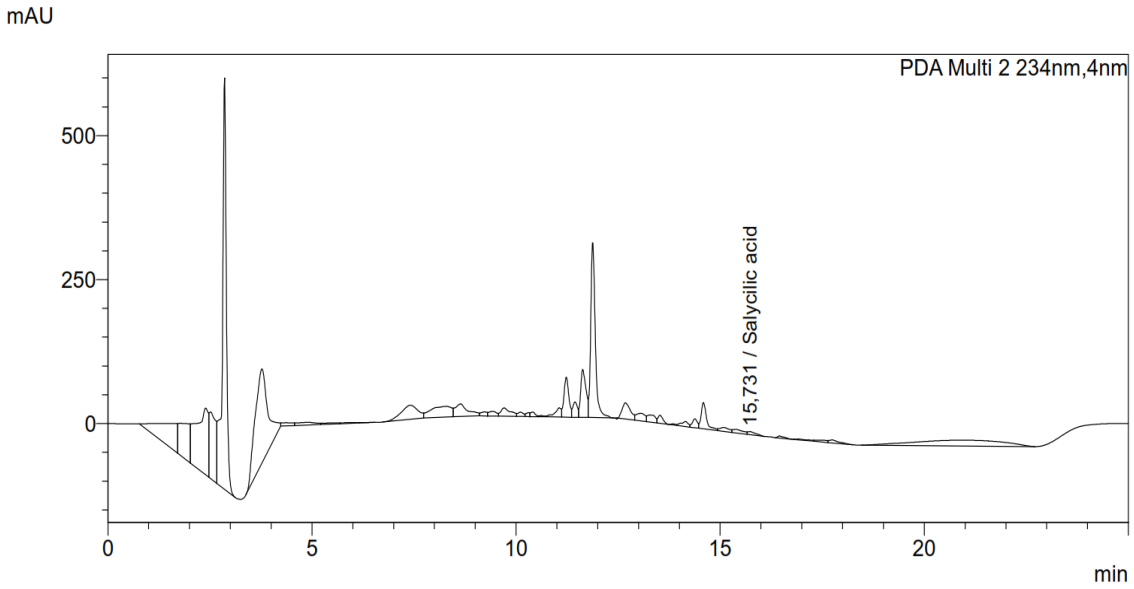


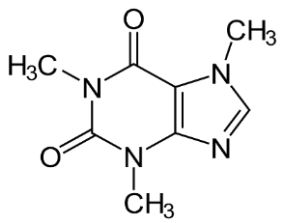
Figure 1. Chromatogram of phenol compounds and coffeein crowth in model extract.

Table 2.

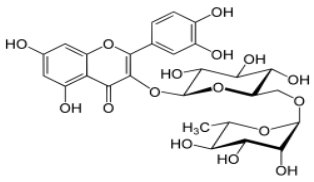
The amount of phenol compounds and coffeine in extract.

Phenolic Invation Name	Time, sek	Concentration, mg/l	100 g An amount in sample, mg
Gallic acid	has not been identified		
Caffeine	11,63	26,054	65,135
Rutin	13,07	1,214	3,035
Quercetine	16,93	0,438	1,095
Salycilic acid	15,73	1,565	3,913

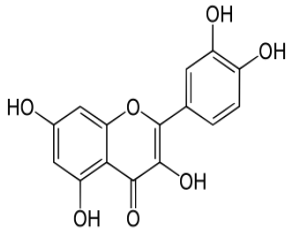
The properties of phenolic compounds found in the plant are described below:



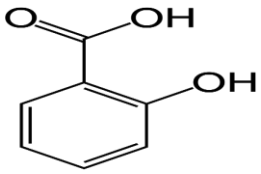
Caffeine is an alkaloid compound belonging to the purine group, naturally found in coffee (Coffea arabica), tea (Camellia sinensis), guarana, cocoa, kola nuts, and certain medicinal plants [9]. It has a stimulating effect on the central nervous system, increases alertness, reduces fatigue, and enhances both mental and physical performance [10]. Caffeine works by blocking adenosine receptors, thereby reducing drowsiness, increasing heart rate, and stimulating the respiratory centers [11]. In medicine, it is used for conditions such as headaches, low blood pressure, and bronchial asthma. Additionally, it is widely used in dietary products and energy drinks. However, excessive consumption may cause side effects such as insomnia, increased heart rate, and irritability [12]. The biological activity, widespread occurrence, and therapeutic potential of caffeine make it an important substance in modern phytotherapy.



Rutin is a biologically active compound belonging to the flavonoid glycoside group and is mainly found in Bidens tripartita, buckwheat (Fagopyrum esculentum), citrus fruits, rose petals, pepper plants, and other medicinal herbs [13]. The primary pharmacological effects of rutin include antioxidant, capillary-strengthening, anti-inflammatory, and angioprotective properties [14]. It neutralizes free radicals and protects cells from oxidative stress, making it widely used in cardiovascular disease treatments [15]. Moreover, it has a synergistic effect with vitamin C, reducing vascular permeability and improving blood circulation. Rutin is considered one of the most potent bioflavonoids and plays a vital role in strengthening the immune system and reducing allergic reactions. It is extracted from natural sources and is widely used in dietary supplements, cosmetic products, and pharmaceutical preparations [16].



Quercetin is a polyphenolic compound belonging to the natural flavonoid class and is widely found in medicinal plants, including Bidens tripartita, onions (Allium), apples, berries, buckwheat, and leafy green vegetables [17]. It possesses strong antioxidant properties, protecting cells from oxidative stress by neutralizing free radicals [18]. In addition, it exhibits anti-inflammatory, antiallergic, immunomodulatory, antiviral, and anticancer effects [19]. Quercetin inhibits the degranulation of mast cells and reduces histamine release, making it useful in treating allergic conditions. Recent studies have also demonstrated its potential antiviral activity against the COVID-19 virus [20]. In the pharmaceutical industry, quercetin is used in various bioactive supplements and phytopreparations.



Salicylic acid is a naturally occurring phenolic compound found in plants such as birch bark, Bidens tripartita, white willow, chamomile, and other medicinal plants [21]. In plants, it acts as a physiological signaling molecule that regulates stress responses. Salicylic acid is especially widely used in dermatology due to its anti-inflammatory, antiseptic, and keratolytic properties, proving effective against acne, dermatitis, and psoriasis [22]. It also serves as a primary precursor in the synthesis of acetylsalicylic acid (aspirin), which underlines its importance in modern pharmacology. Salicylic acid increases cell wall permeability, enhancing the plant's natural defense against microorganisms. It is included in many cosmetic products, ointments, and medications [23]. Thus, salicylic acid is considered a universal therapeutic agent among natural active substances.

As can be seen from the table, using high-performance liquid chromatography (HPLC), it was determined that the dry extract of Bidens contains the highest amount of caffeine—65.135 mg, followed by salicylic acid—3.913 mg, rutin—3.035 mg, and quercetin—1.095 mg. Phenolic compounds possess antioxidant properties, neutralizing free radicals and playing an important role in human health. These compounds also exhibit cytoprotective, vasoprotective, neuro- and cardioprotective, anti-inflammatory, antimicrobial, and antiviral activities. Conclusion in summary, Bidens is a medicinal plant with therapeutic properties and can be used in folk medicine for treating inflammatory conditions of the respiratory tract, diathesis, itching, psoriasis, neurodermatitis, and seborrhea of the scalp.

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