Phenolic Substances and Biological Activities of *Verbana officinalis* L.: A Mini-Review

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**Abstract**

The published data related to the identification of the major phenolic compounds as well as its biological activities present in *Verbana officinalis* L. This plant has received a great interest in the worldwide for its diuretic, expectorant and anti-rheumatic, anti-inflammatory, antifungal, antibacterial, analgesic and antioxidant activities.

**Keywords**: *Verbana officinalis* L; Phenolic substances; Biological activities

**Introduction**

*Verbena officinalis* or commonly referred as vervain belongs to the verbenaceae family (Table 1) which can be found in West Asia, North Africa and throughout Europe [1]. It is listed in the Chinese Pharmacopoeia and the British Herbal Pharmacopoeia [2]. Verbana is a medicinally used herb, where most people still depend on the folk medicine, despite the great progress in all opathic medicines, particularly to all eviateanxiety, insomnia, depression [3]. *Verbena officinalis* has been widely used for amenorrhea, insufficient lactation (lactogogue plant), assisting contractions during labor, promoting wound healing and for disorders of menstruation [4].

**Table 1**: Taxonomical Classification.

| Kingdom          | Plantae                                      |
|------------------|----------------------------------------------|
| Subkingdom       | Tracheobionta – Vascular plants              |
| Super division   | Spermatophyta – Seed plants                  |
| Division         | Magnoliophyta – Flowering plants             |
| Class            | Magnoliopsida – Dicotyledons                 |
| Sub class        | Asteridae                                    |
| Order            | Lamiales                                     |
| Family           | Verbenaceae – Verbena family                 |
| Genus            | Verbena L. – vervain                         |
| Species          | *Verbana officinalis* L.                    |

**Botanical Characteristics**

*Verbena officinalis* is a perennial herb. It is erect, 25–100 cm tall and branched above. Its leaves are 3.5–8 cm long and 1.5–3.5 cm broad. It has pale pink or purplish color flowers about 4 mm across [5] (Figures 1 & 2).
The Chemical Composition of *Verbana officinalis*

Table 2: Phenolic compounds analysis techniques of *Verbana officinalis* L.

| Phenolic Compounds Analysis Techniques of *Verbana officinalis* | Conditions | Major component | References |
|--------------------------------------------------------------|-------------|----------------|------------|
| LC-MS                                                        | Gas temperature of 350°C, nitrogen flow rate of 10 L min⁻¹, nebulizer pressure 30 psi, Quadrupole temperature 30°C, Capillary voltage 3500 V. The applied fragmentors were in the range 80–180 V. | Verbenalin | [6] |
|                                                             | The compounds were detected either at 205 or 235 nm. Calibration data confirmed linearity of the detector response within the concentration range injected (R² from 0.997 to 0.999), and revealed detection limits ranging from 5.0 µg mL⁻¹ (verbascoside) to 13.6 µg mL⁻¹ (hastatoside). The five markers were readily | Verbascoside, Hastatoside, Eukovoside or isomer | [10] |
| A micellar electrokinetic capillary chromatography: MECC     | UPLC separation was achieved using a Waters Acquity BHE C18 Column (150 3.9 mm i.d. 1.7 mm particle size maintained at 25°C), with a mobile phase flow rate of 0.4 mL/min. The mobile phase contained acetonitrile-ammonium acetate 5 mmol/L (A) and water-ammonium acetate (B) in different proportions. The elution system was: 0-5 min, 93-90% of B; 5-8 min, 90-80% of B; 8-13 min, 80% of B; 13-30 min, 80-40% of B and 30-40 min, 40% of B. | Luteolin-7-O-β-D-diglucuronic acid, Apigenin-7-O-β-D-diglucuronide | [8] |
| LC-MS/MS                                                    | Capillary energy, 3500 V; nebulizer gas, 34.8 psi; dry gas, 10.0 L/min at a temperature of 280°C; scan range, m/z 100–1000 with a scan rate of 2 Hz; quadrupole, ion energy 5 eV; low mass m/z 300.00; collision cell, collision energy 10 eV; transfer time, 60 µs; collision RF, 266.7 Vpp; prepulsetorage, 10 µs; transfer, funnel 1 RF 250.0 Vpp, funnel 2 RF 300.0 Vpp, hexapole RF 454.8 Vpp. | Luteolin 7-O-diglucuronide, Verbascoside | [9] |
| UHPLC-DAD                                                   | Capillary energy, 3500 V; nebulizer gas, 34.8 psi; dry gas, 10.0 L/min at a temperature of 280°C; scan range, m/z 100–1000 with a scan rate of 2 Hz; quadrupole, ion energy 5 eV; low mass m/z 300.00; collision cell, collision energy 10 eV; transfer time, 60 µs; collision RF, 266.7 Vpp; prepulsetorage, 10 µs; transfer, funnel 1 RF 250.0 Vpp, funnel 2 RF 300.0 Vpp, hexapole RF 454.8 Vpp. | Luteolin 7-O-diglucuronide, Apigenin 7-O-diglucuronide | [9] |

The main class of compounds of these plants were phenylpropanoids, being verbascoside the most abundant in all the preparations up to 97% of the total phenylpropanoids. In addition, iridoids, has hastatoside and verbenalin together with flavonoids, mono- and di-glucuronidic derivatives of luteolin and apigenin were found [6] (Table 2).
Several analytical techniques were used in order to identify and quantify the phenolic composition of Verbena officinalis, these techniques included high-performance liquid chromatography-mass spectrometry (LC-MS) [6,7], high-performance liquid chromatography-mass spectrometry/mass spectrometry LC-MS/MS [8], ultra-high performance liquid chromatography diode array detector UHPLC-DAD [9], Micellar electro kinetic chromatography MECC [10] and High-performance liquid chromatography with diode-array detection HPLC-DAD [7] (Table 3).

| S.No | Name of compounds                        | Types          | Article |
|------|------------------------------------------|----------------|---------|
| 1    | Hastatoside                              | Iridoid glucoside | [9]     |
| 2    | Verbenalin                               | Iridoid glucoside | [9]     |
| 3    | Luteolin 7-O-diglucuronide               | Flavonoid       | [9]     |
| 4    | Pedalitin 6-O-(2-O-feruloyl)-diglucuronide | Flavonoid       | [7]     |
| 5    | Scutellarein 7-O-(2-O-feruloyl)-diglucuronide | Flavonoid       | [7]     |
| 6    | Pedalitin 6-O-diglucuronide              | Flavonoid       | [7]     |
| 7    | Apigenin 7-O-diglucuronide               | Flavonoid       | [7]     |
| 8    | Aucubin                                  | Iridoid         | [7]     |
| 9    | Scutellarein 7-O-diglucuronide           | Flavonoid       | [7]     |
| 10   | 1,5-O-dicaffeoylquinic acid              | Phenolic acid   | [7]     |
| 11   | 4,5-O-dicaffeoylquinic acid              | Phenolic acid   | [7]     |
| 12   | Luteolin 7-O-gluconuride                 | Flavonoid       | [7]     |
| 13   | Scutellarein 7-O-gluconuride             | Flavonoid       | [7]     |
| 14   | Luteolin 7-O-glucoside                   | Flavonoid       | [7]     |
| 15   | Pedalitin 6-O-galactoside                | Flavonoid       | [7]     |
| 16   | Pedalitin 6-O-glucoside                  | Flavonoid       | [7]     |
| 17   | Apigenin 7-O-galactoside                 | Flavonoid       | [7]     |
| 18   | Apigenin 7-O-glucoside                   | Flavonoid       | [7]     |
| 19   | Scutellarein 7-O-glucoside               | Flavonoid       | [7]     |
| 20   | Verbascoside                             | Phenolic acid   | [9]     |
| 21   | Isoverbascoside                          | Phenolic acid   | [8]     |
| 22   | Apigenin                                 | Flavonoid       | [7]     |
| 23   | Campneoside II                           | Phenylethanoid  | [8]     |
| 24   | Isnocampenoide II                        | Phenylethanoid  | [8]     |
| 25   | 4‴-acetyl-O-isoverbascoside              | Phenylethanoid  | [8]     |
| 26   | 2″,4″-diacetyl-O-verbascoside            | Phenylethanoid  | [8]     |
| 27   | 3‴,4‴-diacetyl-O-isoverbascoside         | Phenylethanoid  | [8]     |
| 28   | 4″,6″-diacetyl-O-betonyoside A           | Phenylethanoid  | [8]     |
| 29   | 3‴,4‴-diacetyl-O-betonyoside A          | Phenylethanoid  | [8]     |
| 30   | Betonyoside A                            | Phenylethanoid  | [8]     |
| 31   | 6‴-acetyl-O-isoverbascoside              | Phenylethanoid  | [8]     |
| 32   | 4‴-acetyl-O-isoverbascoside              | Phenylethanoid  | [8]     |

The Biological Activities of Verbana officinalis

The famous properties of vervain herb are sedative, antispasmodic and diaphoretic [11]. Verbena officinalis L. has been traditionally used as nerve tonic, antidepressant, and anticonvulsant; prescribed in liver and gall bladder complaints (spasm of the bladder and strangury), nervous and menstrual disorders; also, for bronchitis, asthma and febrile affections [12].

In addition to that, Verbana officinalis can be utilized to treat enteritis, acute dysentery, depression and amenorrhea [13]. The scavenging activity against DPPH (1,1-diphenil-2-picrylhydrazyl) radical and the antifungal effect against chloroform, ethylacetate and 50% methanolic extracts of Verbena officinalis leaves were investigated. The activity of different fractions of 50% methanolic extract and some isolated compounds were also investigated. The
results suggest that 50% methanolic extract and caffeoyl derivatives could potentially be considered as excellent and readily available sources of natural antifungal and antioxidant compounds [2].

The antimicrobial potential of verbana herb leaves, and roots was evaluated against 24 strains of Gram-positive and Gram-negative bacteria by Dildar [5]. Ethanolic extracts of stems, leaves, and roots of Verbena officinalis and their fractions in various solvents were assessed. The stems proved to be most potent against all the strains. Its activity against Staphylococcus aureus and Pseudomonas aeruginosa was higher than the antibiotic Amoxicillin.

The leaves also showed considerable activity against Pseudomonas aeruginosa, Citrobacter freundii, and Staphylococcus aureus. The roots turned out to be highly effective against Bacillus subtilis, Staphylococcus aureus, and Pseudomonas aeruginosa. The study confirmed the efficacy of Verbena officinalis against infections diseases. While all the three parts of the plant were active against the test micro-organisms, stems were most powerful. The plant has great potential to provide exploitable leads for new antimicrobial drugs [5].

Conclusion

The biological activities of Verbana officinalis L., including antioxidant, anti-microbial, anti-inflammatory and anti-cancer, were due to the presence of bio-active compounds in the leaves such as: Verbenalin, Hastatoside, Verbascoside, Luteolin-7-O-β-D-diglucuronide, Apigenin-7-O-β-D-diglucuronide. The leaves also showed considerable activity against Pseudomonas aeruginosa, Citrobacter freundii, and Staphylococcus aureus. The roots turned out to be highly effective against Bacillus subtilis, Staphylococcus aureus, and Pseudomonas aeruginosa. The study confirmed the efficacy of Verbena officinalis against infections diseases. While all the three parts of the plant were active against the test micro-organisms, stems were most powerful. The plant has great potential to provide exploitable leads for new antimicrobial drugs [5].

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