Platanus orientalis Linn.

Review of Literature

1.0. Introduction

Medicinal plants have been directly or indirectly used for the treatment of different ailments in most of the developing countries, as a basis for the maintenance of good health [1]. In the world more than 30% of the pharmaceutical preparations are based on plants [2]. In mountain areas different indigenous systems of medicine exist since centuries and cater the needs of nearly 70% human population and livestock [3]. However, an increasing reliance on the use of medicinal plants in the industrialized societies has been traced to the extraction and development of several drugs and chemotherapeutics from the plants. The use of medicines from plants in the form of local medicine dates back to 4000-5000 B.C. The medicinal and aromatic plants have played a vital role in alleviating human sufferings [4]. The medicinal values of these plants are due to the presence of small doses of active compounds which produces physiological actions in the human and animal body [5].

Platanus orientalis Linn. (Plantanaceae) is a woody perennial tree of temperate areas found in Asia, Europe and eastern Mediterranean regions of the world [6]. Seven species of Platanus are distributed throughout the plant kingdom. The most widespread of them is P. orientalis Linn. (Plane-tree), which reaches a height of 55-60 m. It is also found across the planes of Kashmir and is used as a highly valued ornamental tree. It is grown for shade in parks and on the road sides. The plant contains proanthocyanidin glycosides [7-9], flavonol glycosides [10], phenolics [11-13], carbohydrate components [14], fatty acids [15], phytol derivatives [16] and flavonoids [17,18] as its main chemical constituents. Medicinal use of this plant is well known as its extracts and isolated compounds can be directly or indirectly used for the treatment of different ailments such as ophthalmia, dysentery, toothache [19,20]. It is also known to possess antimicrobial [12] and anticancer [21] activities. The chemical composition of the leaves has been studied to a comparatively greater extent than that of the trunk bark. The hydrolysates contain quercetin, myricetin, cyanidin, and delphinidin [22,23]. Fallen leaves of plane tree are rich in α-tocopherol, its oxidized dimeric forms along with esters of higher fatty acids [24,25] and
carbohydrates [26]. The trunk bark contains neutral phytosterols (sito- and stigma-), α-tocopherol and polyphenols [27] in addition to triterpenoids such as betulinic acid, betulinic aldehyde, platanoic acid and 3-dehydroplatanoic acids and sitosterol [23, 28]. Trunk bark is used in folk medicine to treat dysentery, toothache, diarrhoea [29,30] and as an anticancer agent [31]. Leaves of plane-tree are used in folk medicine as a wound-healer and an ophthalmologic agent and roots are used as a hemostatic agent and antivenom for snake bite [9]. Phytol derivatives from the leaves of plane-tree show anti-ulcer activity [32]. Persian scientists and hakims such as Avicenna and Hakim Momen were also familiar with this tree and mentioned its medicinal uses like tooth pain killer, analgesic and anti-inflammatory in their books [33,34]. The hydroalcoholic and polyphenolic extracts of Platanus orientalis Linn. have been shown to possess moderate antinociceptive activity [35]. In the bud extract of Platanus orientalis Linn. the major cytotoxic component was thought to be flavonol glycoside, kaempferol 3-(2′′,3′′-di-E-p-coumaroylhrhamnoside) because its presence significantly modulated the proliferation of HL60 (a promyelocytic cell line) and MOLT3 (a T-ALL with phenotypic characteristics of cortical thymocytes) [36]. Previous research has indicated that Platanus pollen is a major contributor to pollinosis symptoms [37,38]. A high prevalence of positive skin prick tests for P. orientalis Linn. pollen extract (43%) has been recorded in Mashhad, Iran.

2.0. Phytochemistry

Platanic acid was first isolated from Platanus hybrids [39] and (Figure 1) has been reported to exhibit anti-HIV effect [40].

![Figure 1. Platanic acid](image-url)
Chemical investigation of the leaves of *P. orientalis* (Figure 2) has led to the isolation of an acylated flavonol glycoside, 3’,5,7-trihydroxy-4’-methoxyflavonol3-[O-2-O-(2,4Dihydroxy)-E-cinnamoyl-α-L-rhamnopyranosyl-(1→6)]-β-Dglucopyranosyl (1→2)]-β-D-glucopyranoside [41].

![Figure 2. Acylated flavonol glycoside](image)

Adsorption chromatography of the ethyl acetate fraction of the aqueous-alcohol bark extract on microcrystalline cellulose and gel filtration over Sephadex LH-20 has resulted in the isolation of seven pure compounds [9] including five catechins (Figure 3) and two dimeric proanthocyanidins (Figure 4).

![Figure 3. Catechins](image)
Two pure oligomeric glycosylated proanthocyanidins (Figures 4 & 5) have been reported from the butanol fraction of the aqueous-alcohol extract of the trunk bark of *Platanus orientalis* Linn. when subjected to column chromatography [8] over finely crystalline cellulose followed by gel-filtration over Sephadex LH-20.

**Figure 4.** Dimeric Proanthocyanidins

\[\text{R} = \text{O-}\beta\text{-D-Glp} \quad \& \quad \text{R}_1 = \text{Galloyl}\]

**Figure 4.** 7-O-β-D-Glcp-(−)-epicatechingallate-(4β-8)-(−)-epicatechin-(4β-8)-(−)-epicatechin-(4β-8)-5-O-β-D-Glcp-epicatechingallate
\[
R = \text{-O-}\beta\text{-D-Glc} \rightarrow \text{O-}\beta\text{-D-Glc} \\
R_1 = \text{-O-}\beta\text{-D-Glc} \rightarrow \text{O-}\beta\text{-D-Glc} \rightarrow R_2 \\
R_2 = \text{-Galloyl}
\]

**Figure 5.** 7-O-\(\beta\)-D-Glcp\(\rightarrow\)6-O-\(\beta\)-D-Glcp-(\(-\)epigallocatechingallate-(4\(\beta\)-8)-(\(+\)catechingallate-(4\(\beta\)-8)-(\(+\)catechingallate-(4\(\beta\)-8)-(\(-\)epigallocatechingallate-(4\(\alpha\)-8)-(\(-\)epicatechin-(4\(\beta\)-8)-[5-O-\(\beta\)-D-Glcp\(\rightarrow\)6-O-\(\beta\)-D-Glcp\(\rightarrow\)6-galloyl(-)epigallocatechingallate.\]

The aqueous ethanolic extract of *P. orientalis* trunk bark was fractionated according to polarity of the organic solvents to produce fractions of low-molecular-weight, oligomeric, and polymeric proanthocyanidins [7]. Two new pure oligomeric glycosylated proanthocyanidins (**Figure 6**), platanoside-A (I) and platanoside-B (II) have been reported from the butanol fraction of the aqueous ethanolic extract of *P. orientalis* trunk bark when subjected to column chromatography over finely crystalline cellulose and gel filtration over Sephadex LH-20. The elemental composition of I and II being (C\(_{58}\)H\(_{51}\)O\(_{27}\)) and (C\(_{107}\)H\(_{93}\)O\(_{55}\)) respectively.
Phytochemical studies on *Platanus orientalis* Linn. so far have revealed the presence of typical constituents like phenolics, catechins, flavonol glycosides, oligomeric and polymeric proanthocyanidins. Amongst them, some exhibit strong bioactivities, especially analgesic, anti-inflammatory, anti-HIV, antiscrobutic and antirheumatic activities.

Keeping this in mind we have selected *Platanus orientalis* Linn. in order to explore its anti-inflammatory and analgesic properties along with the isolation of active phytoconstituents responsible for the activity.