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Phytochemical analysis and biological activities of the aerial parts of *Odontites vulgaris* Moench

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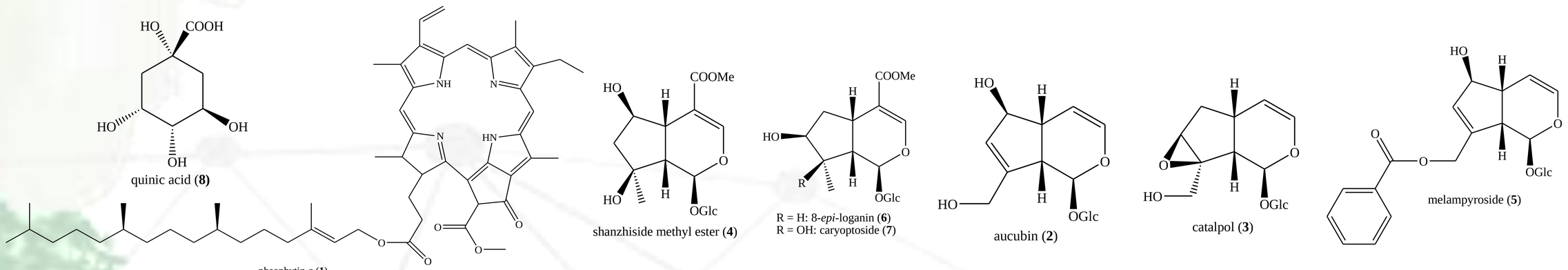
Odontites vulgaris Moench is an herbaceous hemiparasitic annual plant belonging to the Orobanchaceae family and morphologically characterized by: taproots; an erected and pubescent stem with a quadrangular section and bearing many branches; oppositely arranged, sessile or briefly petiolate, lanceolate leaves with briefly dentated margins; an elongated raceme as inflorescence; hermaphrodite, tetracyclic and verticillated flowers blooming from May to October; a pentameric and bilabiate corolla deprived of the spur and pink-violet colored; a dehiscent, obovate, and pubescent capsule as fruit; numerous, quite long and large seeds needing the presence of the roots of the nearby plant to sprout [1].

The species is distributed in Europe, the Middle East and Northern and Central Asia but it has been also introduced into southern Canada [2]. In Italy it can be found everywhere along the national territory except for Liguria, Emilia Romagna, Sardinia, Apulia, Campania, and Basilicata regions and it wildly grows from 0 to 1500 m. a.s.l. preferring humid environments with a calcareous substrate [3].

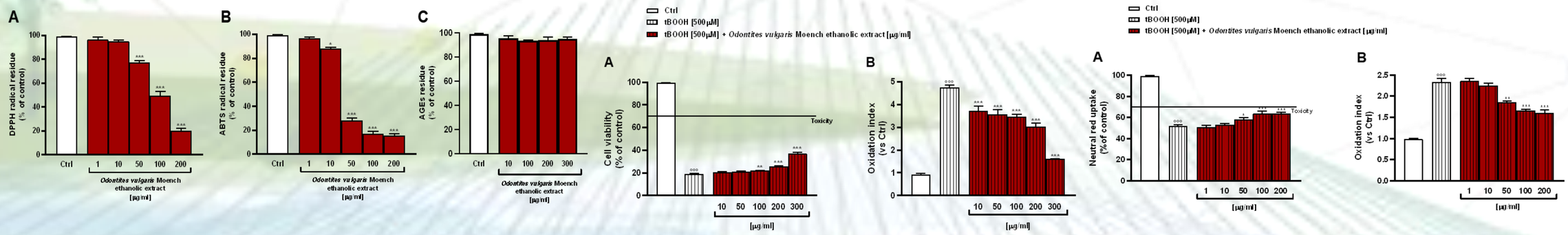
The species has been studied for its phytochemical content only a few times before evidencing the presence of iridoids, phenylethanoid glycosides, flavonoids, polyols, and other phenolic compounds [4-6] always in samples coming from China. In addition, only a couple of biological studies have been performed on the species evidencing the amazing anti-inflammatory effects on LPS-induced inflammation in RAW 264.7 cells of the *n*-butanol fraction derived from the hydro-alcoholic extract of the whole plant and the strong inhibitory activity on COX-2 of the ethanolic extract of the whole plant [5,6]. By the way, the species has a long tradition of use in the Mongolian folklore medicine as anti-arthritic agent [5,6].

In this work, the phytochemical analysis on the aerial parts of this species collected in Italy was performed and the derived ethanolic extract was tested for its radical scavenging, antiglycative, antifungal, aflatoxin B1 production inhibitory, cytoprotective and immunomodulatory activities. These were conducted following specific protocols and methodolgies [7-12].

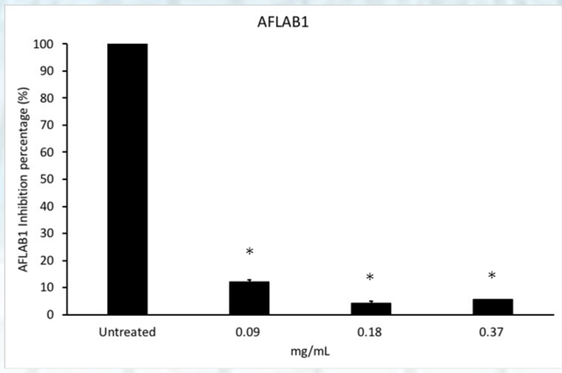
The phytochemical analysis evidenced the presence of eight compounds namely pheophytin *a* (**1**), aucubin (**2**), catalpol (**3**), shanzhiside methyl ester (**4**), melampyroside (**5**), 8-*epi*-loganin (**6**), caryoptoside (**7**) and quinic acid (**8**). Among these, caryoptoside (**7**) and quinic acid (**8**) were isolated from the genus for the first time during this study.



Under our experimental conditions, the ethanolic extract of *O. vulgaris* aerial parts, showed radical scavenging properties against both $DPPH^{\cdot}$ (Figure A, left) and $ABTS^{\cdot+}$ radicals (Figure B, left) but did not counteract the production of AGEs (Figure C, left). In addition, it showed to counteract the oxidative damage caused by tBOOH in human intrahepatic H69 cholangiocytes, in a concentration dependent manner, by restoring cell viability (Figure A, middle) and the basal ROS levels (Figure B, middle), as well as in in RAW 264.7 macrophages even if to a minor extent (Figures A and B, right).



The extract did not show antifungal activity on *Aspergillus flavus* NRRL 3357 but could inhibit the production of aflatoxin B1 in the same strain.



All these biological effects can be explained by the phytochemical compounds present in the extract. In fact, some of them are well knonw to exert those activties [13-15].

Basing on these results, this extract may indeed have an important possible employment in the pharmacological and agronomic fields.

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