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Total Phenolic and Flavonoid Content and Antioxidant Activity of *Epimedium grandiflorum* C. Morren Extract

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Abstract: *Epimedium grandiflorum* C. Morren (Berberidaceae) is a perennial plant native to Japan, China, and North Korea, used for centuries in traditional Chinese medicine. Its pharmacological potential is largely attributed to prenylated flavonoids, yet the species remains under-researched compared to related *Epimedium* species. This study aimed to evaluate the phenolic and flavonoid content and the antioxidant activity of a dried *E. grandiflorum* extract redissolved in 70% ethanol. Total phenolic content was determined by the Folin–Ciocalteu method, total flavonoid content by the aluminium chloride colorimetric assay, and antioxidant activity by the DPPH, ABTS, and FRAP assays. All analyses were performed in triplicate using a UV-Vis spectrophotometer, and results were expressed as gallic acid (GAE), quercetin (QE), and Trolox (TE) equivalents per gram of dried extract. The extract contained 121.75 ± 1.17 mg GAE/g total phenolics and 111.57 ± 0.28 mg QE/g total flavonoids. Antioxidant activity was 0.66 ± 0.05 mmol TE/g (DPPH), 0.88 ± 0.06 mmol TE/g (ABTS), and 0.60 ± 0.01 mmol TE/g (FRAP). These results show that *E. grandiflorum* extract is a source of phenolic compounds and flavonoids with antioxidant activity in all three assays.

Keywords: *Epimedium grandiflorum*; prenylated flavonoids; polyphenols; antioxidant activity; DPPH; ABTS; FRAP

• Introduction

Epimedium grandiflorum C. Morren (Berberidaceae) is a perennial plant found in Japan, China, and North Korea. For centuries it has been used in traditional Chinese medicine for its aphrodisiac, anti-osteoporotic, and estrogen-like properties, in the treatment of erectile dysfunction, osteoporosis, rheumatoid arthritis, and menopausal symptoms. Its therapeutic potential is largely attributed to prenylated flavonoids such as icariin and epimedins A–C. Despite its widespread traditional use, the species is under-researched compared to related *Epimedium* species. The aim of this study was to evaluate the phenolic and flavonoid content and the antioxidant activity (DPPH, ABTS, FRAP) of an *E. grandiflorum* extract.

• Material and method

Dried extract (~0.1 g) → Dissolved in 10 mL 70% ethanol → Centrifugation 20 min, 6000 rpm → Dilution in the calibration range

Total phenolics (TPC)
Folin–Ciocalteu method; 765 nm; 2 h incubation in the dark; mg GAE/g

Total flavonoids (TFC)
$AlCl_3$ colorimetric assay; 30 min incubation in the dark; mg QE/g

Antioxidant activity
DPPH (515 nm), ABTS (734 nm), FRAP (593 nm); 2 h in the dark; mmol TE/g

Analysis
UV-Vis spectrophotometer (Jasco V 530); all analyses in triplicate; mean ± SD

Table 1. Calibration curves (y = ax + b) used for quantification.

Assay	Standard (range)	Equation	R^2
TPC	Gallic acid (25–250 mg/L)	y = 0.001294x + 0.037471	0.9999
TFC	Quercetin (1–100 mg/L)	y = 0.0045x + 0.0384	0.9991
DPPH	Trolox (0.1–0.6 mmol/L)	y = 70.7158x + 5.8592	0.9935
ABTS	Trolox (0.1–0.6 mmol/L)	y = 67.8729x + 3.3698	0.9991
FRAP	Trolox (0.1–0.6 mmol/L)	y = 1.3409x + 0.0171	0.9973

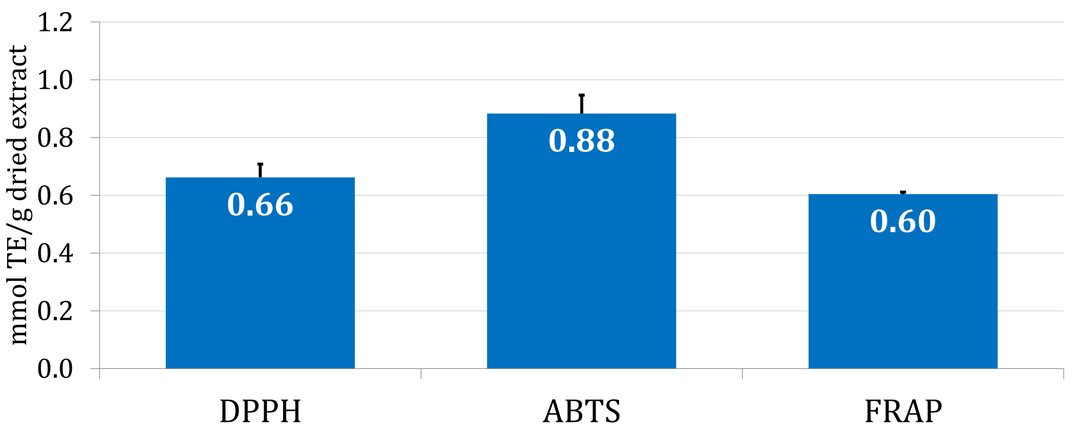
• Results and discussions

Table 2. Total phenolic and flavonoid content and antioxidant activity of the *E. grandiflorum* extract.

Parameter	Mean ± SD	Unit
Total phenolic content (TPC)	121.75 ± 1.17	mg GAE/g dried extract
Total flavonoid content (TFC)	111.57 ± 0.28	mg QE/g dried extract
DPPH	0.66 ± 0.05	mmol TE/g dried extract
ABTS	0.88 ± 0.06	mmol TE/g dried extract
FRAP	0.60 ± 0.01	mmol TE/g dried extract

Results are expressed as mean ± standard deviation (n = 3). TPC = total phenolic content; TFC = total flavonoid content; GAE = gallic acid equivalents; QE = quercetin equivalents; TE = Trolox equivalents; DPPH = 1,1-diphenyl-2-picrylhydrazyl radical scavenging; ABTS = 2,2’-azinobis(3-ethylbenzothiazoline-6-sulfonic acid) radical cation scavenging; FRAP = ferric reducing antioxidant power.

Figure 1. Antioxidant activity of the *E. grandiflorum* extract (mean ± SD, n = 3).



- TFC was close to TPC, suggesting that flavonoids are a major part of the phenolic fraction.
- Antioxidant activity followed the order ABTS > DPPH > FRAP, with low variability between triplicates (RSD ≤ 7.3%).

• Conclusions

- *E. grandiflorum* extract contained 121.75 ± 1.17 mg GAE/g total phenolics and 111.57 ± 0.28 mg QE/g total flavonoids.
- The extract showed antioxidant activity in all three assays (ABTS 0.88, DPPH 0.66, FRAP 0.60 mmol TE/g).
- These data contribute to the phytochemical and antioxidant characterization of this under-researched species.

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