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**Research Article**

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# Phytochemical Studies on *Koelreuteria elegans*

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**ABSTRACT**

*The present study was undertaken for phytochemical composition and antioxidant activity of bark, leaves and seeds of Chinese rain tree (Koelreuteria elegans). Total phenols in methanol extract of bark, leaves and seed cake were found to be 99.3 ± 1.2 mg GAE/g, 109.1 ± 2.5 mg GAE/g and 60.0 ± 0.1 mg GAE/g respectively. Total flavonoids in the methanol extract of bark, leaves and cake were found to be 26.9 ± 0.4 mg CAE/g, 36.3 ± 0.2 mg CAE/g and 10.0 ± 0.06 mg CAE/g respectively. Antioxidant activity of the extracts were determined by DPPH free radical scavenging method and was found to be 96% at concentration of 0.06 mg/ml in the bark extract and 95% at conc. of 0.07 mg/ml in the leaf extract and 93% at conc. of 0.07 mg/ml in the seed cake extract respectively. $EC_{50}$ was 0.023 ± 0.002 mg/ml for bark extract, 0.022 ± 0.002 mg/ml for leaf extract and 0.025 ± 0.01 mg/ml for the seed cake extract respectively.*

**Keywords:** *Koelreuteria elegans*; Total phenols; Flavonoids; Antioxidant activity

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## INTRODUCTION

*Koelreuteria elegans* (Chinese rain tree) is an ornamental landscape tree belonging to family Sapindaceae. It is native tree of Taiwan. It is a fast growing species and tolerant of a wide range of environmental conditions. The other species *K. paniculata*, *K. bipinnata*, *K. henryi* are widely distributed in Northern China. Local people use the seeds of *K. elegans* as insecticides and the leaves as anti-fungal and anti-bacterial agent. Crude extract of this plant also possess anti-tumor and anti-oxidant activities. Roots, bark, twigs and leaves of *K. henryi* have been used for the treatment of diarrhea, malaria and urethritis in traditional folk medicine. It also exhibits significant anti-proliferation activity against cancer cell lines. Seeds of *K. bipinnata* have vitamins A, $D_2$, and E.

## MATERIALS AND METHODS

### Total Phenolic Content

The phenolic substance was determined by the technique of Folin-Ciocalteu reagent [1].

### Flavonoids

The aluminum chloride colorimetric measure [2] was used. The absorbance was examined at 510 nm using UV observable spectrophotometer. Mean flavonoid substance was imparted as mg catechin reciprocals per gram of the concentrate (mg CAE/g).

### Determination of Antioxidant Activity

Antioxidant activity studied by (DPPH) free radical scavenging method [3] and the scavenging activity of the extract will be calculated as:

$$\text{Inhibition (\%)} = [(\text{Abs(control)}-\text{Abs(sample)}] \times 100 / \text{Abs(control)}$$

**Data Analysis**

The obsevation were completed in replicate and results were determined as mean of three replicates ± standard deviation. Quantifiable was completed utilizing Microsoft Excel 2007.

## RESULTS AND DISCUSSIONS

**Total Phenolic Content**

Phenolics are aromatic secondary plant metabolites and high-level antioxidants because of their ability to scavenge free radicals and active oxygen species such as singlet, superoxide free radicals and hydroxyl radicals. Natural polyphenols have chain-breaking antioxidant activities. It is well known that phenolic substances contribute directly to the antioxidant activity of plant materials. In fact, phenolic compounds exhibit considerable free radical-scavenging activities (through their reactivity as hydrogen-donating or electron-donating agents) and metal ion-chelating properties [4]. Therefore, the amount of total phenols in the methanolic extracts of bark, leaves and defatted seed cake were determined. Our results showed that the contents of total phenols were 99.3 ± 1.2 (bark extract), 109.1 ± 2.5 (in leaf extract) and 60.0 ± 0.1 mg GAE/g (seed cake extract). The phenolic content in the leaves of other species namely *K. paniculata* was reported 210 and 240 mg GAE/g in butanol and aqueous extract [5] (Figure 1).

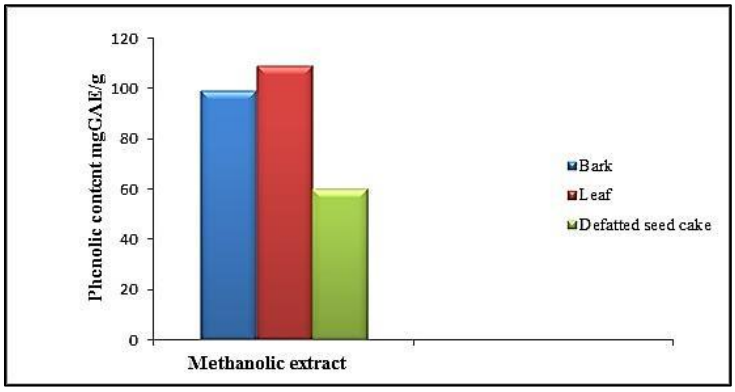


**Figure 1: Total phenolic content of methanolic extract of bark, leaves and defatted seed cake of *K. elegans***

**Flavonoid Content**

Flavones and flavonols are the subgroups of flavonoids. Flavonols are known to act as antioxidant, both as radical scavengers [6] and as metal chelators [7]. The aglycones of these flavonols were reported to be more active than their glycosides [8]. Flavonoids have the ability to scavenge active oxygen radical, superoxide and hydroperoxide by single electron transfer. Superoxide is a biologically important substance which can be decomposed to form stronger oxidative species such as singlet oxygen and hydroxyl radicals [9]. The highly reactive hydroxyl radicals can cause oxidative damage to DNA, lipids and proteins [10]. In the present study the flavonoid content in methanol extracts of bark, leaves and defatted seed cake were determined. Our results showed that the content of total flavonoid was 26.9 ± 0.4 (bark extract), 36.3 ± 0.2 (leaf extract) and 10.0 ± 0.06 mg CAE/g (seed cake extract) (Figure 2).

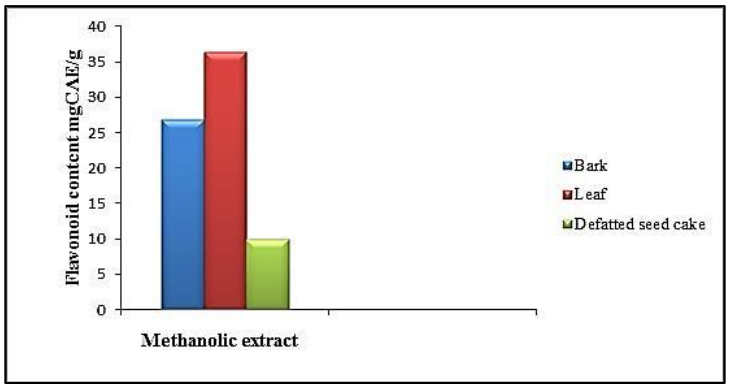


**Figure 2: Flavonoid content in methanolic extract of bark, leaves and defatted seed cake**

**Antioxidant Activity**

Antioxidants affect the process of lipid oxidation at different stages due to differences in their mode of action. Oxidation of lipids is a very complex process resulting in a great variety of oxidation products. Many factors particularly temperature, light and the presence of initiators (metal enzymes), influence the oxidation process and resulting products. Therefore, the antioxidant activity in the methanolic extracts of bark, leaves and defatted seed cake were determined.

**DPPH Method**

Various radicals formed during lipid oxidation are among the main causes for oxidative damage to human health [11]. Antioxidants can exercise their protective function by scavenging free radicals, which are the main propagators of lipid oxidation. 2,2'-diphenyl-1-picrylhydrazyl radical is one of the few stable and commercially available organic nitrogen radical (DPPH$^{\bullet}$), often used in the evaluation of radical scavenging activity of antioxidants-natural and synthetic pure compounds [12,13]. Methanolic solutions of DPPH$^{\bullet}$ have a characteristic absorption maximum at 517 nm. When an electron or hydrogen atom donating antioxidant (AH) is added to DPPH$^{\bullet}$ a decrease in absorbance at 517 nm takes place due to the formation of the non-radical form DPPH-H, which does not absorb at 517 nm. Originally, it was monitored by ESR spectroscopy and relied on the signal intensity of DPPH$^{\bullet}$ being inversely related to the antioxidant concentration and the reaction time. More recently, this reaction has been measured by the de-coloration assay where the decrease in absorbance at 517 nm produced by the addition of the antioxidant to the DPPH$^{\bullet}$ in methanol or ethanol is measured.

$$DPPH^{\bullet} + AH \longrightarrow DPPH\text{-}H + A^{\bullet}$$

All the above described extracts were screened for radical scavenging activity against DPPH$^{\bullet}$. The antioxidant activity ($EC_{50}$) exhibited by methanolic extract of bark, leaves and defatted seed cake of *K. elegans* were 0.023 ± 0.002, 0.022 ± 0.002 and 0.025 ± 0.001 mg/ml respectively. The maximum antioxidant activity exhibited by methanolic extract of bark leaves and defatted seed cake was 96, 95 and 93% respectively at concentration of 0.06, 0.07 and 0.07 mg/ml of the extract respectively. The antioxidant activity ($EC_{50}$) value of the butanolic extract of leaves of *K. henryi* was reported 0.003 mg/ml [14] (Figures 3 and 4).

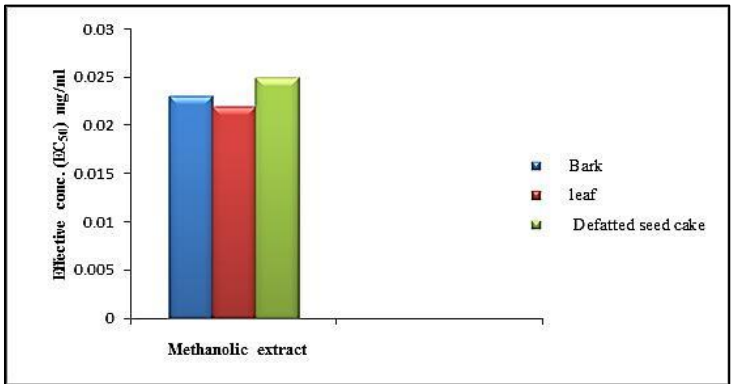


**Figure 3: Antioxidant activity ($EC_{50}$) of methanolic extract of bark, leaves and seed cake**

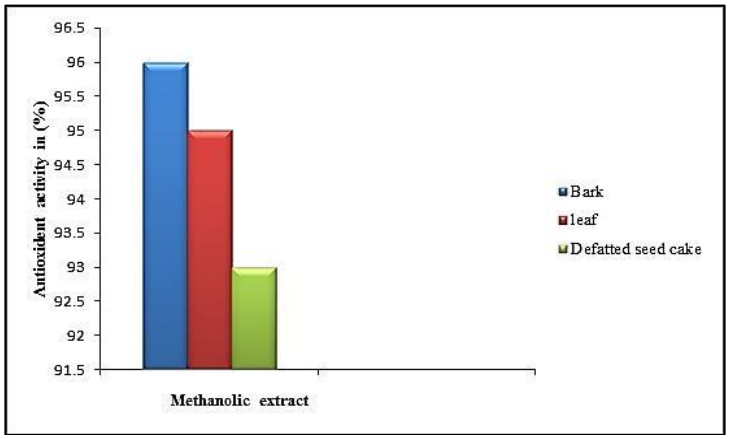


**Figure 4: Antioxidant activity (%) of methanolic extract of bark, leaves and the seed cake**

## CONCLUSION

The Folin-Ciocalteu reagent detected all phenolic groups present in the extracts [15]. This also indicated that factors other than total phenolics play a role in the antioxidant activity of the extracts. Moreover, all the phenolics do not have the same antioxidant activity, some are powerful, others are weak and they develop antagonistic or synergistic effects with themselves or with the other constituents of the extracts [16-18]. This meant that either their components do not possess, good hydrogen donating properties or that some kinetic factors influenced their reaction with the radical or that their components interfere with the radical scavenging process [19] reported that the radical scavenging activity of particular antioxidant depended on structure as well as on the type of reaction kinetics.

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