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Bioactive constituents from *Peltophorum pterocarpum* (DC.) flowers

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ABSTRACT

The chemical investigation of metanolic extract of the flowers of P. pterocarpum belonging to the family Leguminosae led to the isolation of four bioactive phytoconstituents. These are characterized as hentriacontanol, bergenin, kaempferol and quercetin. The isolated compounds were characterized using various spectroscopic data as well as chemical studies.

Keywords: *Peltophorum pterocarpum*, Leguminosae, Methanolic extract, Bioactive constituents

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INTRODUCTION

Peltophorum pterocarpum (Copperpod, Golden Flamboyant, Yellow Flamboyant, Yellow Flame Tree, Yellow Poinciana and Radhachura in Bengali; Synonyms: *Peltophorum inermis* and *Peltophorum ferrugineum*) belongs to the family Leguminosae native to tropical southeastern Asia and a popularly ornamental tree grown around the world including India. It is a deciduous tree growing to 15–25 m (rarely up to 50 m) tall, with a trunk diameter of up to 1 m. The leaves are bipinnate, 30-60 cm long, with 16-20 pinnae, each pinna with 20-40 oval leaflets 8-25 mm long and 4-10 mm broad. The flowers are yellow, 2.5-4 cm diameter, produced in large compound racemes up to 20 cm long. The fruit is a pod 5-10 cm long and 2.5 cm broad, red at first, ripening black, and containing one to four seeds. Trees begin to flower after about four years [1-2].

The plant is native to tropical southeastern Asia and northern Australasia, in Sri Lanka, Thailand, Vietnam, Indonesia, Malaysia, Papua New Guinea, Philippines and the islands of the coast of Northern Territory, Australia [1,3]. The plant is also found in different regions of India including Birbhum District, West Bengal. The wood of the plant is wide variety of uses, including cabinet-making [4] and the foliage is used as a fodder crop [1].

P. pterocarpum is a deciduous tree commonly used for ornamental purpose and as an avenue tree. Different parts of this tree are used to treat many diseases like stomatitis, insomnia, skin troubles, constipation, ringworm and its flower extract is known to be a good sleep inducer and used in insomnia treatment [5-7]. Its bark is used as medicine for dysentery, as eye lotion, embrocation for pains and sores. The traditional healers use the leaves in the form of decoction for treating skin disorders. Stem infusion of the plant used in dysentery, for gargles, tooth powder and muscular pain [8]. Flowers are used as an astringent to cure or relieve intestinal disorders after pain at childbirth, sprains, bruises and swelling or as a lotion for eye troubles, muscular pains and sores [9]. Crude organic extracts including methanol extract of different parts of this plant are reported to exhibit promising biological activities

[5,8,10-17]. The aim of the present study is to isolate and characterize the phytoconstituents from the methanolic extract of flowers of *P. pterocarpum*.

MATERIALS AND METHODS

Phytochemical Investigation

General Experimental Procedures: All the melting points were recorded on Model No. Chemiline-715 melting point apparatus and were uncorrected. IR measurements were obtained on Perkin-Elmer (FT-IR) infrared spectrophotometer. TMS has been used as internal standard in recording ^{1}H-NMR spectra (Bruker DRX300), ^{13}C-NMR Spectrum was performed on 100 MHz instrument (Bruker DRX 300) using TMS as internal standard and EIMS Spectrum was carried out on JEOL-JMS 600 (70 eV). TLC was carried out using Silica-gel 60/ UV254 using precoated plates. Silica-gel (60-120 mesh) was used for Column Chromatography.

Plant Material: The flowers of *P. pterocarpum* were collected from Santiniketan, Birbhum District, West Bengal, India during July, 2012. It was authenticated by Dr. H.R. Choudhury, Dept. of Botany, Visva-Bharati, Santiniketan, West Bengal, India. A voucher specimen of the plant has been kept in the Department of Chemistry, Kulti College.

Preparation of the methanol extract

The flowers of *P. pterocarpum* were collected and dried in shade. The dried flowers were powdered (0.75kg) and exhaustively extracted by Soxhlet apparatus with methanol for 56h. Then the methanol layer was decanted off. The solvent of the extract was distilled off by using rotary evaporator and the brown syrupy material thus obtained was evaporated to dryness and a brown mass (about 12.3 g) was obtained. The preliminary phytochemical studies were performed for testing the different phytoconstituents present in the methanolic extract. The chemical tests revealed the presence of flavonoids, phenolics and aliphatic alcohols.

Isolation of compounds from methanol soluble fraction

The methanol soluble fraction (11.5g) was dissolved in minimum volume of methanol and adsorbed onto silica gel (60-120 mesh, 35g). After evaporation of the solvent, the sample was loaded on column packed with about 190g of Silica-gel prepared in Petroleum ether (60-80^{0}C). The column was then eluted with different solvents with increasing polarity starting from n-hexane (100%) and ending with methanol (100%). The elutions were monitored by TLC (Silica gel-G; visualization by UV 254 nm, 366 nm and Vanillin-Sulphuric acid spraying reagent heated at 110^{0}C).

Elutions carried out with Pet. ether (60-80^{0}C): chloroform (1:3) resulted a single white amorphous solid and the product was designated as **Compound 1** (88 mg).

Elutions carried out with Pet. ether (60-80^{0}C): ethylacetate (2:3) resulted a single white needle solid and designated as **Compound 2** (91 mg).

Elutions carried out with Chloroform: methanol (1:2) resulted a single yellow needle crystalline solid and designated as **Compound 3** (71 mg).

Elutions carried out with Chloroform: methanol (1:3) resulted another single yellow amorphous solid and designated as **Compound 4** (82 mg).

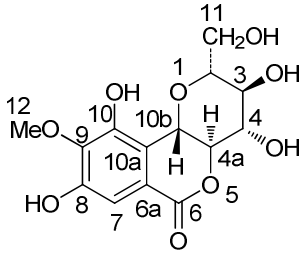
CHARACTERIZATION

Hentriacontanol (1): White amorphous solid, mp 88-90 ºC; IR (KBr): 3400-3160, 2951, 2852, 1481, 1458, 1078, 1051, 732-721, 711 cm^{-1}; ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.88 (3H, t, *J* = 7.5 Hz , -CH_3), 1.26 (58H, bs, 29xCH_2), 1.6 (1H, s, -OH), 3.66 (2H, t, *J* = 7.5 Hz, -CH_2OH); ^{13}C NMR ($CDCl_3$, 100 MHz): δ 14.1, 22.7, 25.7, 29.5, 29.9, 32.0, 32.8, 63.1; EIMS (rel. int., %): *m/z* at 452 ([M]$^{+}$, 0.21), 434 (0.20), 420 (10.0), 392 (7.2), 364 (0.5), 307 (3.8), 279 (1.8), 251 (2.4), 223 (6.1), 195 (12.3), 167 (6.9), 139 (15.3), 111 (26.8), 97 (68.7), 57 (100, base peak), 55 (58.8). All data are identical with that of hentriacontanol [18]

$Me(CH_2)_{30}OH$

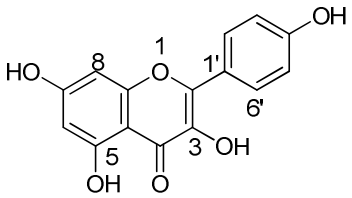
Hentriacontanol (**1**)

Bergenin (2): White needles, mp 235 ^{o}C; ^{1}H NMR (DMSO-d$_6$, 400 MHz): δ 6.49 (1H, m, H-7), 5.67 (1H, d, H-10b), 5.09 (1H, dd, H-4a), 3.98 (1H, dd, H-4), 3.81 (2H, d, H-11), 3.77 (3H, s, H-12), 3.59 (1H, m, H-2), 3.5 (1H, dd, H-3); ^{13}C NMR (DMSO-d$_6$, 100 MHz): δ 60.1 (C-12), 61.1 (C-11), 70.9 (C-3), 72.1 (C-10b), 73.9 (C-4), 79.8 (C-4a), 81.8 (C-2), 109.7 (C-7), 116.2 (C-10a), 118.1 (C-6a), 140.8 (C-9), 148.3 (C-10), 151.1 (C-8), 163.4 (C-6). All data are identical with that of bergenin [19-24].



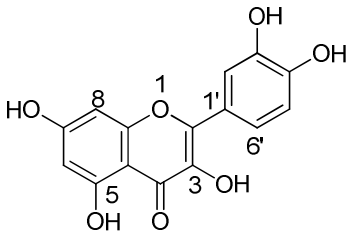
Bergenin (**2**)

Kaempferol (3): Yellow needle crystals, mp 275-277ºC. The compound **3** responded Shinoda test for flavonoids. UV (MeOH): λ_{max} 265, 367 nm; ^{1}H NMR (300 MHz, DMSO-d_6): δ 8.09 (2H, d, *J* = 8.8 Hz, H-2′, 6′), 6.91 (2H, d, *J* = 8.8 Hz, H-3′, 5′), 6.38 (1H, bs, H-8), 6.13 (1H, bs, H-6); ^{13}C NMR (MeOH, 100 MHz): δ 155.2 (C-2), 133.1 (C-3), 176.8 (C-4), 160.9 (C-5), 98.8 (C-6), 164.5 (C-7), 93.6 (C-8), 156.2 (C-9), 104.5 (C-10), 120.7 (C-1'), 130.7 (C-2'), 114.9 (C-3'), 159.8 (C-4'), 115.0 (C-5'), 130.7 (C-6'). All data were identical with that of kaempferol [25].



Kaempferol (**3**)

Quercetin (4): Yellow amorphous powder, mp 311-313^{0}C. The compound **4** responded Shinoda test for flavonoids. UV (MeOH): λ_{max} 258, 369 nm; ^{1}H NMR (DMSO-d_6, 300 MHz): δ 6.17 (1H, *d*, *J* = 2.0 Hz, H-6), 6.39 (1H, *d*, *J* = 2.0 Hz, H-8), 6.87 (1H, *d*, *J* = 8.0 Hz, H-5'), 7.60 (1H, *dd*, *J* = 2.0, 7.5 Hz, H-6'), 7.72 (1H, *d*, *J* = 2.0 Hz, H-2'); ^{13}C NMR (MeOH, 100 MHz): δ 147.8 (C-2), 137.3 (C-3), 177.4 (C-4), 162.4 (C-5), 99.4 (C-6), 165.6 (C-7), 94.5 (C-8), 158.3 (C-9), 104.5 (C-10), 124.0 (C-1'), 116.1 (C-2'), 146.2 (C-3'), 148.7 (C-4'), 116.3 (C-5'), 121.5 (C-6'). All data are identical with that of quercetin [26-28]



Quercetin (**4**)

RESULTS AND DISCUSSION

Chromatographic separation of the methanol extract of flower of *P. peltophorum* led to the isolation of four bioactive constituents characterized as hentriacontanol, bergenin, kaempferol and quercetin using spectroscopic techniques like UV, IR, ^{1}H NMR, ^{13}C NMR and EIMS as well as chemical studies. All these isolated phytochemicals are reported to exhibit significant biological activities [29-36].

CONCLUSION

The phytochemical investigation of the methanol extract of the flowers of *P. peltophorum* belonging to the family Leguminosae was successfully carried out. The chemical constituents isolated from this extract must account for the biological activities exhibited by the crude methanol extract of the plant. Therefore, it is now turn of the pharmacologists/biologists to explore the plant more systematically by carrying out individual bioactivity of the isolated chemical constituents. Therefore, the present work will boost the scientific communities to do more research work on this important medicinal plant to explore it in the drug development programme going on around the world.

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