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Antimicrobial Activity of Friedelan-3β-ol and *trans*-N-Caffeoyltyramine Isolated from the Root of *Vitis trifolia*

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This paper reports friedelan-3β-ol (**1**) and *trans*-N-caffeoyltyramine (**2**), two possible organic substrates, isolated from the root of *Vitis trifolia*. The antimicrobial activity of isolated compound **1** was explained on the basis of presence of hydroxyl groups in the structure capable of forming hydrogen bonds with the active sites of the target enzymes. The presence of aromatic rings and phenolic hydroxyl group could be the contributing factors for the observed higher antimicrobial activity of compound **2**.

Key Words: *Vitis trifolia*, Vitaceae, Friedelan-3β-ol, *trans*-N-Caffeoyltyramine.

INTRODUCTION

Vitis trifolia (family: Vitaceae) is a tropical and subtropical plant with 12 genera and about 700 species[1]. The roots of *Vitis trifolia* are commonly used for healing various diseases related to inflammation in the spleen, liver, blood purification, biliousness, heart troubles, tonic stomachic and expectorant[2,3]. Various tetramers such as, (+)hopeaphenol, isohopeaphenol[4], Vitisin A[5], (+)Vitisifuran A[6] and heyneanol A[7] were isolated from the roots of the species *Vitis amurensis*. Resveratrol, derived from *Vitis vinifera* (family Vitaceae), possess antiinflammatory and antimutagenous activities and also used as a cancer chemopreventive agent[8].

The present investigation, related to extraction of organic compounds from the root of *Vitis trifolia*, has been carried out from the collected species of tribal area of Parlakhemundi, India. The hilly area of Parlakhemundi, situated in Orissa, forms a part of the Eastern Ghats of India. This area is floristically quite interesting for its connection to Himalayan region and many medicinal plants of various kinds are available in the region. The tribal healers are able to successfully use the pulverized root of *Vitis trifolia* plant for the cure of fractured bones of animals as well as human being of

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rural area. Apart from this, the root of the plant is also used for the wound healing purpose. In practice, the root paste is used therapeutically to relieve the pain and inflammation at the wounded sites.

In modern medical practices antibiotics, synthesized by various chemical methods, are used effectively for killing harmful microorganisms at wounded sites. However, many authors also reported an increase in the microbial resistance to the synthetic antimicrobial agents[9,10]. Medicinal plants serves as a rich source of antibacterial and antifungal agents. In this aspect, other researchers have also carried out extensive work on selected Indian medicinal plants and evaluated effectiveness as antimicrobial agent[11].

The present investigation reports friedelan-3β-ol and *trans*-N-caffeoyltyramine, two possible organic substrates, isolated from the root of *Vitis trifolia*. The effect of these isolated compounds upon microorganisms were tested for the purpose of possible development of new antimicrobial reagents obtained from medicinal plant source. The method of isolation, reported in the present study, was simple and efficient. To best of our knowledge, this investigation is first of its kind, which has been carried out from the medicinal plant species *Vitis trifolia* collected from the above locality.

EXPERIMENTAL

The root of *Vitis trifolia* (Vitaceae) was collected locally, identified by the botanist of SKCG College, Parlakhemundi and the voucher specimen (File III/2006) was deposited in the herbarium of the SKCG College, Parlakhemundi.

Column chromatography was carried out using silica gel 60-120 mesh (Ranbaxy). Thin layer chromatography (TLC) was carried out using silica gel G (Ranbaxy). IR spectra of the compounds were recorded in a Jasco IR spectrophotometer using KBr pellet. The FT NMR spectra (Bruker) were recorded using $CDCl_3$ as solvent and TMS as internal standard.

Preparation of extract and purification of water insoluble ethyl alcohol extract residue using column chromatography: The water washed and air-dried and finely divided root (2.5 Kg) extracted with ethyl alcohol (95 %) using soxhlet apparatus. Using column chromatographic technique, the ethyl alcohol extract was run and then eluted with a mixture of dry benzene and dry petroleum benzine in the ratio 1:9. This ratio was found to be optimum for elution in the present investigation. The purity of elute was tested using thin layer chromatography developed in a solvent system of benzene and ethyl acetate (9:1). The ratios of the solvent mixture play an important role in the isolation of organic compounds. Two different spots were observed when the TLC plate was exposed to ultraviolet chamber. The compounds were separately collected and the purity

of the individual compound was further tested on the TLC plates. Characterization of the obtained compounds was done using spectroscopic techniques.

Compound 1: White crystals; m.p. 278-280ºC; $[\alpha]_D^{20°C}$ = +132º, IR (KBr, cm^{-1}): 3752, 2923, 1738. ^1H NMR (300 MHz, $CDCl_3$): δ ppm 3.73 (1H, bd, *J* 3.0 Hz, H-3), 1.867 (1H, dt, *J* 9.5, 3.0 Hz, H-2a), 1.676 (1H, m, H-6a), 1.598 (1H, m, H-2b), 1.52 (2H, m, H-1a, H-16a), 1.49 (1H, m, H-18), 1.47 (2H, m, H-15a, H-22a), 1.45 (1H, m, H-21a), 1.42 (1H, m, H-19a), 1.41 (1H, m, H-1b), 1.36 (2H, m, 2H-7), 1.34 (1H, m, H-11a), 1.31 (1H, m, H-16b), 1.28 (2H, m, 2H-12), 1.27 (1H, m, H-15b), 1.256 (2H, m, H-8, H-21b), 1.22 (1H, m, H-4), 1.14 (3H, s, H-30), 1.091 (1H, m, H-19b), 0.98 (3H, s, H-26), 0.97 (3H, s, H-28), 0.95 (1H, m, H-6b), 0.95 (3H, s, H-27), 0.93 (3H, s, H-24), 0.92 (3H, s, H-29), 0.91 (3H, d, *J* = 7.0 Hz, H-23), 0.85 (1H, m, H-10), 0.82 (3H, s, H-25); ^{13}C NMR (300 MHz, $CDCl_3$): 16.0 (t, C-1), 35.2 (t, C-2), 50.0 (d, C-4), 37.1(s, C-5), 42.1 (t, C-6), 17.9 (t, C-7), 53.6 (d, C-8), 38.2 (s, C-9), 61.8 (d, C-10), 35.6 (t, C-11), 31.0 (t, C-12), 38.7 (s,C-13), 40.0 (s, C-14), 33.2 (t, C-15), 37.0 (t, C-16), 30.1 (s,C-17), 43.2 (d, C-22), 12.0 (q, C-23), 18.8 (q, C-24), 19.0 (q, C-25), 19.0 (q, C-26), 21.0 (q, C-27), 29.7 (q, C-28), 34.7 (q, C-29), 32.0 (q, C-30); FAB-MS m/z : 429 $[M^+H]^+$; appropriate for $C_{30}H_{55}O$.

Compound 2: White crystal, m.p. 217-218ºC; $[\alpha]_D^{20°C}$ = +113º, IR (KBr, cm^{-1}): 1740, 1352, 1279, 1166, 1112, 1028. ^1H NMR (400 MHz, $CDCl_3$) δ ppm: 7.33 (1H, d, *J* = 15.6 Hz, H-7), 7.02 (1H, d, *J* = 1.5Hz, H-2), 7.00 (2H, d, *J* = 8.4 Hz, H-2',6'), 6.95 (1H, dd, *J* = 8.4, 1.5 Hz, H-6), 6.69 (1H, d, *J* = 8.4 Hz, H-5), 6.62 (2H, d, *J* = 8.4 Hz, H-3',5'), 6.30 (1H, d, *J* = 15.6 Hz, H-8), 3.38 (2H, t, *J* = 7.5 Hz, H-8), 2.66 (2H, t, *J* = 7.5 Hz, H-7). ^{13}C NMR (300 MHz, $CDCl_3$) δ ppm: 170.4 (C-9), 159.4 (C-4'), 156.9 (C-4), 138.1 (C-3), 132.3 (C-7), 131.2 (C-1), 130.7 (C-2', 6'), 127.9 (C-1), 121.4 (C-6), 116.2 (C-8), 116.0 (C-5), 42.3 (C-8'), 35.5 (C-7').

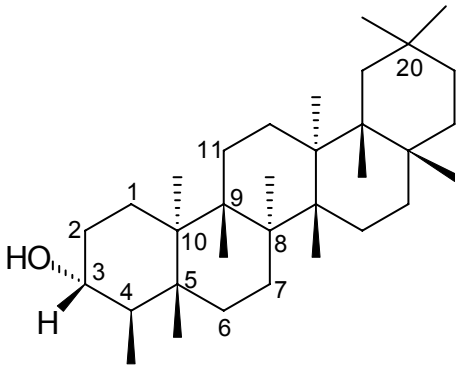
Antimicrobial assay: The antimicrobial activity of the extracts was determined against *Escherichia coli, Staphylococcus aureus* and *Bacillus cereus*. The antibacterial activity, presented in Table-1, was done by two-fold series dilution method[12]. The minimum inhibitory concentration (MIC) was recorded as the lowest concentration at which no bacterial growth was observed.

RESULTS AND DISCUSSION

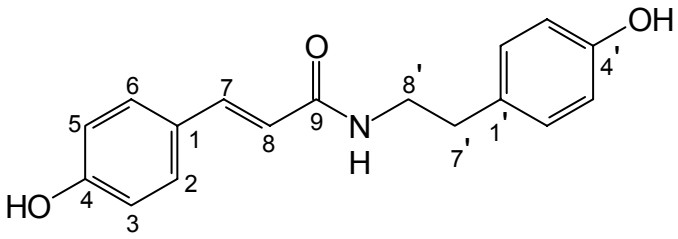
Based on the spectral data, elemental analysis, chemical tests for the presence of aromatic and functional groups, the possible structure 1 and 2 has been assigned to the compound **1** and **2**, respectively. Comparison was made with available literatures data.

TABLE-1
ANTIBACTERIAL ACTIVITY OF COMPOUND **1** AND **2**

Bacteria	Minimum inhibitory concentration (μg/mL)		
	Compound **1**	Compound **2**	Gentamycin
B. cereus	3.11	10.5	6.25
S. aureus	1.54	11.3	24.80
E. coli	0.65	1.11	6.25



Structure 1. Epifriedelanol, Friedelan-3β-ol (**1**)



Structure 2. *trans*-N-Caffeoyltyramine (**2**)

Compound **1** and **2** demonstrated very good activity against gram (+) and gram (-) bacteria. As observed, compound **2** was found to be more active in comparison to compound **1**. In the present case, the antimicrobial activities of both compounds may be explained on the basis of presence of hydroxyl groups capable of forming hydrogen bonds with the active sites of the target enzymes. The presence of aromatic rings and phenolic hydroxyl group could be main factor, which attributed to the observed higher antimicrobial activity of compound **2** in comparison to compound **1**. It may be mentioned that in practice, the traditional healer used to apply the whole root paste on the wounded site for therapeutic purpose. In actual case, in a plant species, antimicrobial activities of the overall extract is

difficult to correlate to a specific compound because the effect may be due to presence of many other active chemicals like terpenes, alcohols, aldehydes and esters and therefore, this complexity and variability may also contribute to the overall antimicrobial activity[13].

Conclusions

The present investigation reports the isolation of two compounds from the root part of the *Vitis trifolia*. To ascertain the therapeutic value, the application of the isolated compounds was tested upon some selected microorganisms and the findings towards inhibition of microorganisms were correlated with a standard drug. The observed result allows us to conclude that the compounds exhibited good antimicrobial activities and can be further developed for application as effective antimicrobial agent. Apart from this, the present study also scientifically supports the therapeutic use of plant materials by indigenous people against a number of infections since generations.

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