

---

**SHORT COMMUNICATIONS**


---

**CHARGED NULL FLUID IN de SITTER BACKGROUND**

Y. K. GUPTA and D. V. GUPTA

*Department of Mathematics, University of Roorkee, Roorkee 247 667, India.*

WE present here a metric whose corresponding energy momentum tensor is an electromagnetic field plus a null fluid and there is a cosmological term. The case without the cosmological term has already been solved by Bonner and Vaidya<sup>1</sup>. Our solution is:

$$ds^2 = 2 du dr + \left( 1 - \frac{2m(u)}{r} + \frac{4\pi e^2(u)}{r^2} - \frac{\lambda}{3} r^2 \right) du^2 - r^2 (d\theta^2 + \sin^2 \theta d\phi^2) \quad (1)$$

with  $v^i = \delta_1^i k$ ,  $k^2 = (4\pi r^2)^{-1} \left( -\bar{m} + \frac{4\pi e \bar{e}}{r} \right)$

$$F_{14} = -F_{41} = r^{-2} e, \quad J^i = -r^{-2} \bar{e} \delta_1^i$$

$$E_j^i = \frac{1}{2} (\delta_1^i \delta_j^1 - \delta_2^i \delta_j^2 - \delta_3^i \delta_j^3 + \delta_4^i \delta_j^4) r^{-4} e^2$$

$$R_j^i = \left( \frac{2\bar{m}}{r^2} - \frac{8\pi e \bar{e}}{r^3} \right) \delta_1^i \delta_j^4 + \frac{4\pi e^2}{r^4} \times (\delta_2^i \delta_j^2 + \delta_3^i \delta_j^3 - \delta_1^i \delta_j^1 - \delta_4^i \delta_j^4) + \lambda \delta_j^i,$$

where an overhead bar denotes ordinary differentiation with respect to  $u$ .

The metric (1) in curvature coordinates takes the form

$$ds^2 = \left[ 1 - \frac{2m(x)}{r} + \frac{4\pi e^2(x)}{r^2} - \frac{\lambda r^2}{3} \right]^{-1} \times \left( -dr^2 + \frac{\dot{x}^2}{x'^2} dt^2 \right) - r^2 (d\theta^2 + \sin^2 \theta d\phi^2) \quad (2)$$

with  $f(x) = x' \left[ 1 - \frac{2m(x)}{r} + \frac{4\pi e^2(x)}{r^2} - \frac{\lambda}{3} r^2 \right]$ ,

where

$x = x(r, t)$ ,  $x' = \partial x / \partial r$ ,  $\dot{x} = \partial x / \partial t$  and  $f(x)$  is an arbitrary function of  $x$ .

The metric (1) with zero cosmological constant ( $\lambda = 0$ ) reduces to Bonnor-Vaidya<sup>1</sup> metric for radiation of charge in Einstein-Maxwell theory. The space-time described by the metric (1) can be regarded as a generalization of the Bonner-Vaidya space-time as it is imbedded in the cosmological background of de Sitter Universe. In case  $e = 0$ , metric (1) reduces to the solution by Mallett<sup>2</sup>. Besides this if we set  $\bar{e} = 0 = \bar{m}$ , metric (1) can be seen as Reissner-Nordström solution imbedded in de Sitter space-time.

The authors express their sincere thanks to Professor S. N. Pandey for valuable discussions.

16 June 1986; Revised 31 July 1986

1. Bonnor, W. B. and Vaidya, P. C., *Gen. Relat. Gravit.*, 1970, **1**, 127.
2. Mallett, R. L., *Phys. Rev.*, 1985, **D31**, 416.

**NEW C-GLYCOSYL FLAVONES FROM ADINA CORDIFOLIA**

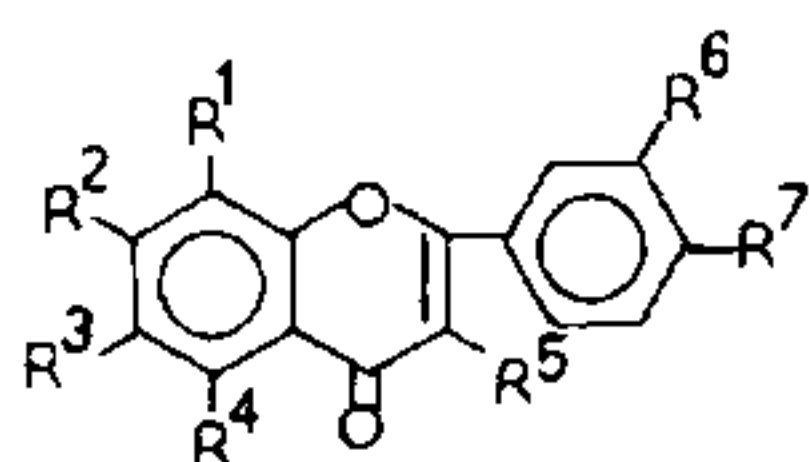
SAVITRI D. SRIVASTAVA and S. K. SRIVASTAVA

*Department of Chemistry,**Dr H. S. Gour Vishwavidyalaya, Sagar 470 003, India.*

THE plant *Adina cordifolia* has been used in local medicine as an antiseptic and febrifuge<sup>1,2</sup>. Evidence is presented for the continuation of our work<sup>3,4</sup> to isolate and characterize three novel C-glycosyl flavones viz quercetin-3, 4'-dimethylether-8-C-rhamnoside; acacetin-5-methylether-8-C-rhamnoside and genkwanin-8-C-rhamnoside on the basis of spectral, chemical and cmr data respectively.

Three glycosyl flavones (viz 1, 2 and 3) were isolated and characterized from the heartwood of *A. cordifolia*. The UV and diagnostic shifts<sup>5</sup> for 1, 2 and 3 were characteristic of 3,4'-di-O, 5-O and 7-O substituted quercetin, acacetin and apigenin respectively which were confirmed as C-glycosides by resistant to usual acid hydrolysis and pmr spectra<sup>6</sup> in CDCl<sub>3</sub>. The pmr spectra of 1 showed the presence of

4×ArH (H-2', 5', 6' and 6), 2×MeO and sugar protons while 2 and 3 exhibited the presence of 5×ArH (H-2', 3', 5', 6' and 6 in each), 2×MeO (in 2), 1×MeO (in 3), C-3 (in 2 and 3 both) and sugar protons respectively. 1, 2 and 3 on treatment with HI in ArOH<sup>7</sup> yielded quercetin-3, 4'-dimethyl ether<sup>8</sup>, acacetin-5-methylether<sup>4</sup> and genkwanin<sup>9</sup> (m.p., uv, ir, pmr, m.m.p. and co-tlc) respectively. FeCl<sub>3</sub> oxidation<sup>7,9</sup> of 1, 2 and 3 afforded L-rhamnose in each case (co-pc and osazone formation). The principal absorptions in the pmr spectra (CDCl<sub>3</sub>) of the acetates<sup>6,10,11</sup> of 1 [ $\delta$ 1.72, 2.03, 2.08 (2'', 3'', 4'' -OAc) and 0.78 (rhamn Me)], 2 [ $\delta$ 1.70, 2.04, 2.06 (2'', 3'', 4'' -OAc) and 0.78 (rhamn Me)] and 3 [ $\delta$ 1.71, 2.03, 2.08 (2'', 3'' and 4'' -OAc) and 0.78 (rhamn Me)] were indicative for 8-C-rhamnosidation in all. The mass spectra of the permethylether (prepared by Hakomori's method<sup>12</sup>) confirmed the presence of L-rhamnose at C-8 in 1, 2 and 3 respectively [1: m/z 560 (M<sup>+</sup>, 75%), 175 (M<sup>+</sup>-385, 100%); 2: m/z 500 (M<sup>+</sup>, 76%), 175 (M<sup>+</sup>-325, 100%) and 3: m/z 500 (M<sup>+</sup>, 76%), 175 (M<sup>+</sup>-325, 100%)]. The cmr data of 1, 2 and 3 in CDCl<sub>3</sub> were also in good agreement with the proposed structures. Thus the compounds-1, 2 and 3 were assigned by the following structures.



1: R<sup>1</sup>=L-RHAMNOSE ; R<sup>2</sup>=R<sup>4</sup>=R<sup>6</sup>=OH ; R<sup>5</sup>=R<sup>7</sup>=MeO ; R<sup>3</sup>=H

2: R<sup>1</sup>=L-RHAMNOSE ; R<sup>2</sup>=OH ; R<sup>3</sup>=R<sup>5</sup>=R<sup>6</sup>=H ; R<sup>4</sup>=R<sup>7</sup>=MeO

3: R<sup>1</sup>=L-RHAMNOSE ; R<sup>2</sup>=MeO ; R<sup>3</sup>=R<sup>5</sup>=R<sup>6</sup>=H ; R<sup>4</sup>=R<sup>7</sup>=OH

**Isolation of C-glycosyl flavones:** The air-dried and powdered heartwood of *A. cordifolia* (3 kg) was extracted with ether at room temperature for 80 hr. The ethereal extract (8 litres) was concentrated under reduced pressure to yield a syrup. The syrup was run on TLC (si gel, pet. ether: C<sub>6</sub>H<sub>6</sub>, 5:5) which showed the presence of three spots. The three bands were separated by prep. TLC (si gel, pet. ether: C<sub>6</sub>H<sub>6</sub>, 5:5) into 1, 2 and 3 (yields 900, 850 and 820 mg) respectively and were found to be TLC and PC pure.

**Compound-1:** M.p. 280–83° (dec);  $\lambda_{\max}^{\text{MeOH}}$  258, 370; + AlCl<sub>3</sub> 260, 390, 435; + AlCl<sub>3</sub>+HCl 257, 422;

+NaOAc 278, 368 and +NaOAc+H<sub>3</sub>BO<sub>3</sub> 260, 372 nm;  $\nu_{\max}^{\text{KBr}}$  3345, 2920, 2865, 1650, 1610, 1530, 1485, 1180, 1075, 1015, 895, 825 and 805 cm<sup>-1</sup>; pmr (CDCl<sub>3</sub>, 90 MHz)  $\delta$ 8.0 (d, J=2.5 Hz, 1H), 7.90 (dd, J=2.5 and 9.0 Hz, 1H), 6.90 (d, J=9.0 Hz, 1H), 6.39 (s, 1H), 4.90 (d, J=7.0 Hz, 1H, H-1'', anomeric-H), 4.0 (s, 3H), 3.95 (s, 3H), 3.55–3.80 (m, 4H) and 0.78 (d, J=7.0 Hz, 3H); ms at m/z 476 (M<sup>+</sup>, 74%), 458 (60), 440 (9), 422 (74), 328 (8), 325 (7), 311 (22), 146 (25), 133 (100) and 117 (80); Found: C, 57.75; H, 5.0; MeO, 12.95; C<sub>23</sub>H<sub>24</sub>O<sub>11</sub> reqd., C, 57.99; H, 5.04; 2×MeO, 13.02%; acetate (Ac<sub>2</sub>O-Py), m.p. 240–42°; pmr (CDCl<sub>3</sub>, 90 MHz)  $\delta$ 8.0 (d, J=2.5 Hz, 1H), 7.85 (dd, J=2.5 and 9.0 Hz, 1H), 6.90 (d, J=9.0 Hz, 1H), 6.39 (s, 1H), 4.90 (d, J=7.0 Hz, 1H), 4.0 (s, 3H), 3.90 (s, 3H), 3.60–3.80 (m, 4H), 2.12, 2.10, 2.08, 2.03, 2.0 and 1.72 (each s, 18H) and 0.78 (d, J=7.0 Hz, 3H); permethylether, m.p. 135–38°; ms at m/z 560 (M<sup>+</sup>, 75%), 545 (25), 398 (8), 395 (7), 367 (20), 188 (25), 175 (100) and 159 (80).

**Action of HI:** 1 (200 mg) and phenol (600 mg), HI (1 ml, d = 1.7) were gradually added and the flask cooled during addition. The mixture was refluxed (137°) to an oil bath for 8 hr. The cooled mixture was poured into aqueous solution of NaHCO<sub>3</sub> with stirring. A yellow substance separated out, it was filtered and crystallized (MeOH) as yellow needles which was identified as quercetin-3, 4'-dimethyl ether (m.m.p. and co-tlc).

**FeCl<sub>3</sub> oxidation:** 1 (100 mg) and FeCl<sub>3</sub> (500 mg) in 4 ml of water were heated in an oil bath (125°) for 6 hr. After cooling and diluting with water, the dark coloured material was filtered off and the filtrate passed through a column of IRA-120 (H) (15 g) followed by IRA-400 (OH) (15 g) to remove Fe<sup>3+</sup> and Cl<sup>-</sup> ions. The neutral solution was concentrated to dryness and L-rhamnose was identified (co-pc and rhamnosazone). cmr (CDCl<sub>3</sub>): aglycone,  $\delta$ 176, 162.8, 160.4, 155.5, 149.6, 146, 141, 136.3, 123.4, 119.9, 115.3, 112.4, 104.8, 98.9, 94.5, 55.8, 55.7; C-rhamnosyl, 100.5, 72.2, 70.9, 70.43, 68.2 and 17.6.

**Compound-2:** M.p. 303–6°;  $\lambda_{\max}^{\text{MeOH}}$  270, 340; + AlCl<sub>3</sub> 270, 345; + AlCl<sub>3</sub>+HCl 270, 340; + NaOAc 270, 355; + NaOEt 270, 340 nm;  $\nu_{\max}^{\text{KBr}}$  3400, 2920, 2870, 1645, 1605, 1520, 1480, 1175, 1080, 1010, 890, 820 and 800 cm<sup>-1</sup>; pmr (CDCl<sub>3</sub>, 90 MHz)  $\delta$ 8.0 (d, J=8.5 Hz, 1H), 7.0 (d, J=8.5 Hz, 2H), 6.70 (s, 1H), 6.39 (s, 1H), 4.90 (d, J=7.0 Hz, 1H), 4.0 (s,



3H), 3.95 (s, 3H), 3.53–3.80 (m, 4H) and 0.78 (d,  $J = 7.0$  Hz, 3H); MS at  $m/z$  444 ( $M^+$ , 74%), 426 (60), 408 (10), 390 (75), 265 (20), 146 (25), 133 (100) and 117 (80); Found: C, 62.0; H, 5.38; MeO, 13.85;  $C_{23}H_{24}O_9$  reqd., C, 62.16; H, 5.40;  $2 \times$  MeO, 13.96%; acetate ( $Ac_2O$ -Py), m.p. 205–7° (dec); pmr ( $CDCl_3$ , 90 MHz)  $\delta$ 8.0 (d,  $J = 8.5$  Hz, 2H), 7.0 (d,  $J = 8.5$  Hz, 2H), 6.70 (s, 1H), 6.39 (s, 1H), 4.90 (d,  $J = 7$ , OH, 1H), 4.0 (s, 3H), 3.90 (s, 3H), 3.55–3.80 (m, 4H), 2.10, 2.06, 2.04 and 1.70 (each s, 12H) and 0.78 (d,  $J = 7.0$  Hz, 3H); permethylether, m.p. 180–84°; ms at  $m/z$  500 ( $M^+$ , 76%), 485 (25), 307 (20), 188 (25), 175 (100) and 159 (80). 200 mg **2** was treated with phenol and HI as usual which yielded acacetin-5-methylether (m.m.p. and co-tlc). 100 mg **2** was oxidised with  $FeCl_3$  as usual to yield L-rhamnose (co-pc and rhamnosazone). cmr ( $CDCl_3$ ): aglycone,  $\delta$ 181.6, 164.3, 163.7, 161.1, 159.9, 156.9, 127.9 (2C), 120.9, 115.5 (2C), 108.5, 104.1, 102.8, 90.2, 56.0, 55.9; C-rhamnosyl,  $\delta$ 100.5, 72.2, 70.9, 70.43, 68.2 and 17.6.

**Compound-3:** M.p. 330–33°;  $\lambda_{max}^{MeOH}$  267, 335; +  $AlCl_3$  275, 340, 388; +  $AlCl_3 + HCl$  272, 305, 342, 389; +  $NaOAc$  286, 348; +  $NaOMe$  265, 402 nm;  $\nu_{max}^{KBr}$  3400, 2920, 2870, 1645, 1608, 1520, 1475, 1170, 1080, 1015, 895, 825 and 805  $cm^{-1}$ ; pmr ( $CDCl_3$ , 90 MHz)  $\delta$ 7.98 (d,  $J = 8.5$  Hz, 2H), 7.0 (d,  $J = 8.5$  Hz, 2H), 6.70 (s, 1H), 6.39 (s, 1H), 4.90 (d,  $J = 7.0$  Hz, 1H), 4.0 (s, 3H), 3.50–3.80 (m, 4H) and 0.78 (d,  $J = 7.0$  Hz, 3H), ms at  $m/z$  430 ( $M^+$ , 75%), 412 (60), 376 (75), 251 (20), 146 (25), 133 (100) and 117 (80); Found: C, 61.29; H, 5.10; MeO, 7.38;  $C_{22}H_{22}O_9$  reqd., C, 61.39; H, 5.12;  $1 \times$  MeO, 7.44%; acetate ( $Ac_2O$ -Py), m.p. 153–54°; pmr ( $CDCl_3$ , 90 MHz)  $\delta$ 8.0 (d,  $J = 8.5$  Hz, 2H), 7.0 (d,  $J = 8.5$  Hz, 2H), 6.70 (s, 1H), 6.39 (s, 1H), 4.90 (d,  $J = 7.0$  Hz, 1H), 4.0 (s, 3H), 3.50–3.80 (m, 4H), 2.10, 2.08, 2.03, 2.0 and 1.71 (each s, 15H) and 0.78 (d,  $J = 7.0$  Hz, 3H); permethylether, m.p. 198–99° (dec); ms at  $m/z$  500 ( $M^+$ , 75%), 485 (25), 307 (20), 188 (25), 175 (100) and 159 (80). 200 mg **3** was treated with phenol and HI as usual to afford genkwanin (m.m.p. and co-tlc). 100 mg **3** was reacted with  $FeCl_3$  by the earlier method to give L-rhamnose (co-pc and rhamnosazone). cmr ( $CDCl_3$ ): aglycone,  $\delta$ 181.5, 164.4, 163.7, 161.1, 159.9, 156.9, 127.9 (2C), 120.9, 115.6 (2C), 108.6, 104.1, 102.8, 90.2, 55.9; C-rhamnosyl,  $\delta$ 100.5, 72.2, 70.9, 70.43, 68.2 and 17.6.

The authors are thankful to the Director, CDRI, Lucknow, India for spectral data and microanalyses

of the compounds. One of us (SDS) is also grateful to UGC, New Delhi for a fellowship.

1 July 1985; Revised 26 May 1986

1. Chopra, R. N., Nayar, S. L. and Chopra, I. C., *Glossary of Indian medicinal plants*, C.S.I.R., New Delhi, 1956, p. 7.
2. Kirtikar, K. R. and Basu, B. D., *Indian medicinal plants*, Lalit Mohan Basu publication, Allahabad, 1933, 2, 1253.
3. Srivastava, S. K., Srivastava, S. D. and Gupta, R. K., *Indian J. Chem.*, 1981, 20, 833.
4. Srivastava, S. D., *Drugs of the future*, 1983, 8, 669.
5. Mabry, T. J., Markham, K. R. and Thomas, M. B., *The systematic identification of flavonoids*, Springer, New York, 1970.
6. Markham, K. R. and Mabry, T. J., *The flavonoids*, (eds) J. B. Harborne, T. J. Mabry and H. Mabry, Chapman and Hall, London, 1975.
7. Narayanan, V. and Seshadri, T. R., *Indian J. Chem.*, 1971, 9, 14.
8. Tiwari, K. P. and Srivastava, S. D., *Planta Medica*, 1979, 35, 188.
9. Chopin, J., Bouillant, M. L., Ramchandran, A. G. N., Ramesh, P. and Mabry, T. J., *Phytochemistry*, 1968, 17, 299.
10. Horowitz, R. M. and Gentili, B., *Chem. Ind.*, 1966, 625.
11. Gentili, B. and Horowitz, R. M., *J. Org. Chem.*, 1968, 33, 1571.
12. Hakomori, S., *J. Biochem.*, 1964, 55, 205.

## EXCESS INTERNAL PRESSURE AND INTERMOLECULAR INTERACTION IN BINARY LIQUID MIXTURES

B. P. SHUKLA and S. N. DUBEY

Department of Chemistry, National Degree College, Barhalganj, Gorakhpur 273 402, India.

INTERNAL pressure has been found to be a very important parameter<sup>1-7</sup> in sonochemical reactions<sup>8-15</sup> i.e. chemical reactions initiated or accelerated by ultrasonic waves). The increasing importance of internal pressure in the theory of liquid state<sup>16</sup> and in sonochemistry inspired us to investigate its