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# Therapeutic Role of *Ricinus Communis* L. Root Bioactive Compounds in Rheumatoid Arthritis

**Priyanka Pandey & Sugandha Tiwari**
**DGPG College, Kanpur.**

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***Corresponding Author Email:**

## Abstract
*Ricinus communis* L. is commonly called castor plant. The plant belongs to family Euphorbiaceae. Plant has a great medicinal value. Each part of the plant is used in the treatment of different disorders. The roots of *Ricinus communis* are widely used in the treatment of different diseases from the very ancient time. Roots of castor plant are used in the treatment of rheumatism, fever and inflammation etc. In the present work phytochemical profiling of *Ricinus* was done through GC-MS analysis. The phytochemical profiling of castor root reveals the presence of different active phytochemicals. Preliminary physicochemical analysis shows total ash content 5.21%, acid insoluble ash 91 %, water soluble ash content 10%. Phytochemical analysis reveals the presence of carbohydrate, protein, phenols, saponins. For the GC-MS profiling of Ricinus two water and methanol extracts were used. Methanol extracts shows more 78 compounds while water based extracts shows 6 compounds.

**Keywords**
*Ricinus communis*, GCMS, phytochemicals.

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**INTRODUCTION:**
In present time people have started to be looking for ancient medicinal system for the treatment of disease as these systems have no side effects, effective and are safe. According to the ancient Indian literature all plant parts have medicinal substances[1]. In India, pharmacological and phytochemical investigation has been carried out only on a very small population of wild plants[2]. Wild plants are the major source of the herbal drugs for the local people and also for the herbal drug industries. Normally the raw material purchased from the market is adultarated[3]. Adulteration and substitution of raw material is a global problem for local people and herbal drug industries.[4] in present study, Ricinus root was selected to authenticate it based on physicochemical, preliminary phytochemical analysis and chemical profiling through GCMS.

Botanical name of castor is *Ricinus communis* L. ‘Eranda’ is a Sanskrit name of castor[5]. Castor belongs to the family Euphorbiaceae. It is a wild flowering plant grow throughout the world. Castor is a fast growing shrub or sometime soft wooded small tree of about 3-5 meter hight. Leaves are green, large 20-25 cm in length and 10-17 cm in breath, petiolate, palmately lobed, 5-7 lobes with serrate margins. Different parts of the plant like root, stem, leaves, seed oil are used in the treatment of inflammatory and liver disorders[6]. Root of Ricinus is sweet in taste and it is used in the treatment of different disorders [7]. In ayurveda, castor roots are used in the treatment of rheumatism, liver disorders, fever, backache etc[8]. The extracts from different parts of the plant shows analgesic, diuretic, anti-asthmatic, anthelmintic and many other medicinal properties [9-14].

**MATERIAL AND METHOD:**

Fresh roots of *Ricinus communis* L. are collected from the different parts of Kanpur U.P. in the month of December and authenticated by Dr. Sugandha Tiwari, Professor, D.G.P.G. College Kanpur. Roots are washed properly, shade dried, powdered in the mechanical grinder. Powdered material is preserved in air tight glass bottles for further use.

**Physicochemical study-**Ash content, water soluble ash, acid insoluble ash, extractive values are determined according to well-known methods and procedure[15, 16, 17].

**Preliminary phytochemical profiling**

**Extract preparation**

The crude drug powder is subjected for the preparation of methanolic and aqueous extract .10 grams of root powder was used for extraction with 200ml methanol, shaken vigorously for 5-10 min and left for 24 h. after which the extract is filtered. Water extract was also prepared by using the same method.100 ml of both the extracts were evaporated to dryness in water bath. Dry extracts were cooled and weighted. Percentage yield (extractive value) was calculated. Remaining 100 ml water and methanolic extract were used for the preliminary phytochemical testing according to the standard procedure[18]

**GCMS analysis**

GC-MS analysis was done by Indian Institute of Science Education and Research, Bhopal. GCMS analysis was done by Agilent 7890 A GC with5975 CMS system, an oven temperature from 50°C to 280°Cat 4°C/min and held at this temperature for 5 min; inlet and interface temperatures were 250°C and280°C, respectively. Carrier gas was He at a flow rate of 1.0 ml/min (constant flow). 0.2 ml of sample was injected under split of 20:1. EIMS: electron energy, 70 eV. Interpretation of mass spectrum GCMS was conducted using data base of NIST, having more than 62,000 patterns. The spectrum of the known compounds was compared with the NIST library.

**RESULT AND DISCUSSION:**

**Physicochemical analysis**

Results of physicochemical analysis were mentioned in table-1(ash value) and table-2(extractive value)

**Table -1 ash content in *Ricinus communis* root**

| Type of ash | Values in % w/w |
|---|---|
| Total ash content | 5.20% |
| Acid insoluble ash | 0.91% |
| Water soluble | 10.80% |

**Table-2 Extractive values**

| Solvent | Extractive values % W/W |
|---|---|
| Water | 10.4 |
| Methanol | 8.6 |

**Phytochemical analysis- results** of preliminary phytochemical analysis of crude drug for the presence or absence of different phytochemicals like alkaloids, tannins and saponins etc. are shown in the table -3.

**Table-3 preliminary phytochemical test of Ricinus communis root**

| Phytochemical test | Water extract | Methanolic extract |
|---|---|---|
| Alkaloid | + | + |
| Carbohydrates | + | + |
| Saponins | + | + |
| Flavonoids | + | + |
| Terpenoids | + | + |
| Protein | - | - |

**+present, -absent**

**Table 4: GCMS Profiling of methanolic extract of *Ricinus* root.**

| Sl.No | Compound | Chem. formula | Mol. wt | Prob. |
|---|---|---|---|---|
| 1. | 2-Methoxy-4-vinylphenol | $C_9H_{10}O_2$ | 150 | 28.4% |
| 2. | Ethanone, 1-(2-hydroxy-5-methylphenyl)- | $C_9H_{10}O_2$ | 150 | 21.8% |
| 3. | 4-Hydroxy-2-methylacetophenone | $C_9H_{10}O_2$ | 150 | 9.92% |
| 4. | 4-Hydroxy-3-methylacetophenone | $C_9H_{10}O_2$ | 150 | 7.60% |
| 5. | Ethanone, 1-(3-methoxyphenyl)- | $C_9H_{10}O_2$ | 150 | 5.97% |
| 6. | 1-(4-Hydroxymethylphenyl)ethanone | $C_9H_{10}O_2$ | 150 | 3.86% |
| 7. | Sucrose | $C_{12}H_{22}O_{11}$ | 342 | 12.6% |
| 8. | d-Glycero-d-ido-heptose | $C_7H_{14}O_7$ | 210 | 9.89% |
| 9. | d-Glycero-d-galacto-heptose | $C_7H_{14}O_7$ | 210 | 5.69% |
| 10. | Galacto-heptulose | $C_7H_{14}O_7$ | 210 | 4.81% |
| 11. | Lactose | $C_{12}H_{22}O_{11}$ | 342 | 4.25% |
| 12. | α-D-Glucopyranoside, O-α-D-glucopyranosyl-(1.fwdarw.3)-β-D-fructofuranosyl | $C_{18}H_{32}O_{16}$ | 504 | 4.25% |
| 13. | Hexadecanoic acid, methyl ester | $C_{17}H_{34}O_2$ | 270 | 77.8% |
| 14. | Pentadecanoic acid, 14-methyl-, methyl ester | $C_{17}H_{34}O_2$ | 270 | 13.0% |
| 15. | Pentadecanoic acid, 13-methyl-, methyl ester | $C_{17}H_{34}O_2$ | 270 | 3.12% |
| 16. | Hexadecanoic acid, 2-methyl- | $C_{17}H_{34}O_2$ | 270 | 3.00% |
| 17. | Pentadecanoic acid, methyl ester | $C_{16}H_{32}O_2$ | 256 | 0.68% |
| 18. | Hexadecanoic acid, 15-methyl-, methyl Ester | $C_{18}H_{36}O_2$ | 284 | 0.57% |
| 19. | n-Hexadecanoic acid | $C_{16}H_{32}O_2$ | 256 | 69.3% |
| 20. | l-(+)-Ascorbic acid 2,6-dihexadecanoate | $C_{38}H_{68}O_8$ | 652 | 18.5% |
| 21. | Palmitic anhydride | $C_{32}H_{62}O_3$ | 494 | 3.76% |
| 22. | Isopropyl Palmitate | $C_{19}H_{38}O_2$ | 298 | 2.05% |
| 23. | i-Propyl 14-methyl-pentadecanoate | $C_{19}H_{38}O_2$ | 298 | 1.12% |
| 24. | i-Propyl hexadecanoate | $C_{19}H_{38}O_2$ | 298 | 0.76% |
| 25. | Pregn-5-en-20-one, 3-(acetyloxy)-17-hydroxy-, (3β)- | $C_{23}H_{34}O_4$ | 374 | 24.8% |
| 26. | Cyclopenta[d]anthracene-8,11-dione, 1,2,3,3a,4,5,6,6a,7,8,11,12-dodecahydro-3-(1-methylethyl)-12-hydroxy- | $C_{20}H_{26}O_3$ | 314 | 16.0% |
| 27. | 5,16,20-Pregnatriene-3beta,20-diol diacetate | $C_{25}H_{34}O_4$ | 398 | 5.36% |
| 28. | 17Alpha-ethynyl-6beta-methoxy-3alpha,5-cyclo-5alpha-androstane-17beta,19-diol | $C_{22}H_{32}O_3$ | 344 | 2.76% |
| 29. | (5β,13β) Androst-8-en-3-one, 17-19-diacetoxy-4,4-dimethyl | $C_{25}H_{36}O_5$ | 416 | 2.65% |
| 30. | 1H-Cyclopropa[3,4]benz[1,2-e]azulene-5,7b,9,9a-tetrol, 1a,1b,4,4a,5,7a,8,9-octahydro-3-(hydroxymethyl)-1,1,6,8-tetramethyl- | $C_{26}H_{36}O_8$ | 476 | 2.55% |
| 31. | trans-Dehydroandrosterone, methyl ether | $C20H_{30}O_2$ | 302 | 7.64% |
| 32. | trans-Dehydroandrosterone, trifluoroacetate | C21H27F3O3 | 384 | 5.85% |
| 33. | Androst-5,7-dien-3-ol-17-one | $C_{19}H_{26}O_2$ | 286 | 5.17% |
| 34. | Vitamin A palmitate | $C_{36}H_{60}O_2$ | 524 | 4.37% |
| 35. | Androst-5-en-7-one, 3-(acetyloxy)-, (3β)- | $C_{21}H_{30}O_3$ | 330 | 4.20% |
| 36. | Dehydroisoandrosterone acetate | $C_{21}H_{30}O_3$ | 330 | 4.03% |
| 37. | Cyclopropanebutanoic acid, 2-[[2-[[2-[(2-pentylcyclopropyl)methyl]cyclopropyl]methyl]cyclopropyl]methyl]-, methyl ester | $C_{25}H_{42}O_2$ | 374 | 13.7% |
| 38. | 1-Heptatriacotanol | $C_{37}H_{76}O$ | 536 | 10.5% |
| 39. | Ursodeoxycholic acid | $C_{24}H_{40}O_4$ | 392 | 3.82% |
| 40. | 9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z,Z,Z)- | $C_{21}H_{36}O_4$ | 352 | 3.37% |
| 41. | 6,9,12,15-Docosatetraenoic acid, methyl ester | $C_{23}H_{38}O_2$ | 346 | 3.24% |
| 42. | Androst-5-ene-17-carbonitrile, 4-acetoxy-17-hydroxy- | $C_{22}H_{31}NO_3$ | 357 | 2.74% |

| | | | | |
|---|---|---|---|---|
| 43. | 9,12-Octadecadienoic acid (Z,Z)- | $C_{18}H_{32}O_2$ | 280 | 6.65% |
| 44. | Ethanol, 2-(9,12-octadecadienyloxy)-, (Z,Z)- | $C_{20}H_{38}O_2$ | 310 | 5.36% |
| 45. | 8,11-Octadecadienoic acid, methyl ester | $C_{19}H_{34}O_2$ | 294 | 4.52% |
| 46. | Ethyl 9,12-hexadecadienoate | $C_{18}H_{32}O_2$ | 280 | 3.82% |
| 47. | Cyclopropaneoctanoic acid, 2-[[2-[(2-ethylcyclopropyl)methyl]cyclopropyl]methyl]-, methyl ester | $C_{22}H_{38}O_2$ | 334 | 3.82% |
| 48. | 9,12-Octadecadienoic acid (Z,Z)-, methyl ester | $C_{19}H_{34}O_2$ | 294 | 3.82% |
| 49. | Podocarp-7-en-3-one, 13β-methyl-13-vinyl- | $C_{20}H_{30}O$ | 286 | 9.26% |
| 50. | Pregnan-20-one, 3-(acetyloxy)-5,6-epoxy-, (3β,5β,6β)- | $C_{23}H_{34}O_4$ | 374 | 9.26% |
| 51. | Pregnan-20-one, 5,6-epoxy-3-hydroxy-, (3β,5α,6α)- | $C_{21}H_{32}O_3$ | 332 | 7.09% |
| 52. | 1-Phenanthrenecarboxaldehyde, 7-ethenyl-1,2,3,4,4a,4b,5,6,7,9,10,10a-dodecahydro-1,4a,7-trimethyl-, [1R-(1α,4aβ,4bα,7β) | $C_{20}H_{30}O$ | 286 | 5.01% |
| 53. | 26,27-Dinorergosta-5,24-dien-3-ol, (3β)- | $C_{26}H_{42}O$ | 370 | 3.83% |
| 54. | Pregn-5-en-20-one, 3,17-dihydroxy-, 3-acetate | $C_{23}H_{34}O_4$ | 374 | 3.39% |
| 55. | Butanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-methanocyclopenta[ | $C_{24}H_{34}O_6$ | 418 | 8.59% |
| 56. | Ethisterone | $C_{21}H_{28}O_2$ | 312 | 6.58% |
| 57. | 1H-2,8a-Methanocyclopenta[a]cyclopropa[e]cyclodecen-11-one, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a,6-trihydroxy-1,4-bis(hydroxymethyl)- | $C_{20}H_{28}O_6$ | 364 | 5.30% |
| 58. | Octanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-methanocyclopenta | $C_{28}H_{42}O_6$ | 474 | 4.89% |
| 59. | 2,4,6-Decatrienoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-;; | $C_{30}H_{40}O_6$ | 496 | 4.70% |
| 60. | 11α-Hydroxyprogesterone, methyl ether | $C_{22}H_{32}O_3$ | 344 | 4.52% |
| 61. | : Butanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-methanocyclopenta | $C_{24}H_{34}O_6$ | 418 | 26.5% |
| 62. | 5aH-3a,12-Methano-1H-cyclopropa[5',6']cyclodeca[1',2':1,5]cyclopenta[1,2-d][1,3]dioxol-13-one, 1a,2,3,9,12,12a-hexahydro- | $C_{23}H_{32}O_5$ | 388 | 23.4% |
| 63. | 2,4,6-Decatrienoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a | $C_{30}H_{40}O_6$ | 496 | 11.4% |
| 64. | Pregn-4-ene-3,20-dione, 11-hydroxy-, (11α)- | C21H30O3 | 330 | 2.68% |
| 65. | 9-Octadecenamide, (Z)- | $C_{18}H_{35}NO$ | 281 | 1.94% |
| 66. | 16-Allopregnen-3β-ol-20-one | $C_{21}H_{32}O_2$ | 316 | 1.72% |
| 67. | Pregn-4-ene-3,6-dione | $C_{21}H_{30}O_2$ | 314 | 43.9% |
| 68. | Tricyclo[5.4.3.0(1,8)]tetradecan-3-ol-9-one, 4-ethenyl-6-(2-hydroxyacetoxy)-2,4,7,14-tetramethyl- | $C_{22}H_{34}O_5$ | 378 | 12.9% |
| 69. | 2,6,10,14-Hexadecatetraene, 1-benzyloxy-9-(phenylthio)-3,7,11,15-tetramethyl- | $C_{33}H_{44}OS$ | 488 | 10.9% |
| 70. | : Retinoic acid, 5,6-epoxy-5,6-dihydro- | $C_{20}H_{28}O_3$ | 316 | 3.03% |
| 71. | 4-(3,3-Dimethyl-but-1-ynyl)-4-hydroxy-2,6,6-trimethylcyclohex-2-enone | $C_{15}H_{22}O_2$ | 234 | 2.44% |
| 72. | 1-[2-[2-Bromoacetamido]ethyl]hypoxanthine | $C_9H_{10}BrN5O_2$ | 299 | 2.25% |
| 73. | 4H-Cyclopropa[5',6']benz[1',2':7,8]azuleno[5,6-b]oxiren-4-one, 8-(acetyloxy)-1,1a,1b,1c,2a,3,3a,6a,6b,7,8,8a-dodecahydro-3a | $C_{22}H_{30}O_8$ | 422 | 8.47% |
| 74. | Octanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-methanocyclopenta | $C_{28}H_{42}O_6$ | 474 | 7.48% |
| 75. | 2,4,6-Decatrienoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a- | $C_{30}H_{40}O_6$ | 496 | 6.61% |

| | | | | |
|---|---|---|---|---|
| 76. | Dodecanoic acid, 1a,2,5,5a,6,9,10,10a-octahydro-5,5a-dihydroxy-4-(hydroxymethyl)-1,1,7,9-tetramethyl-11-oxo-1H-2,8a-methanocyclopenta | $C_{32}H_{50}O_6$ | 530 | 5.84% |
| 77. | (5β,13α) 3α-Methoxy-3β,19-epoxyandrost-8-ene-7α,17β-diol, 4,4-dimethyl- | $C_{22}H_{34}O_4$ | 362 | 5.62% |
| 78. | Hexadecanoic acid, 1-(hydroxymethyl)-1,2-ethanediyl ester | $C_{35}H_{68}O_5$ | 568 | 5.62% |

**Table 5: GCMS Profiling of water extract of *Ricinus* root**

| Sl.no. | Compound | Mol.formula | Mol.wt | Prob. |
|---|---|---|---|---|
| 1 | 9-Octadecenamide, (Z)- | $C_{18}H_{35}NO$ | 281 | 76.1% |
| 2 | 9-Octadecenamide | $C_{18}H_{35}NO$ | 281 | 12.0% |
| 3 | Deoxyspergualin | $C_{17}H_{37}N_7O_3$ | 387 | 3.46% |
| 4 | cis-11-Eicosenamide | $C_{20}H_{39}NO$ | 309 | 2.10% |
| 5 | 9-Octadecenamide, 12-hydroxy-, [R-(Z)]- | $C_{18}H_{35}NO_2$ | 297 | 1.61% |
| 6 | 13-Docosenamide, (Z)- | $C_{22}H_{43}NO$ | 337 | 1.54% |

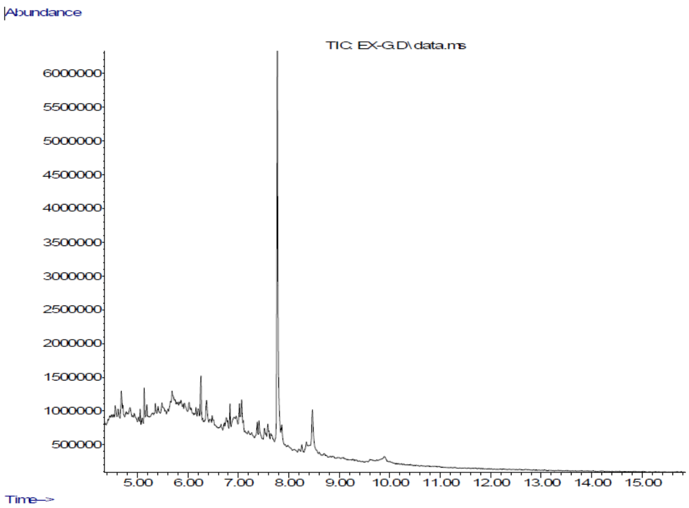


**Fig1: GC-Mass Spectrum of the Water extract of *Ricinus communis***

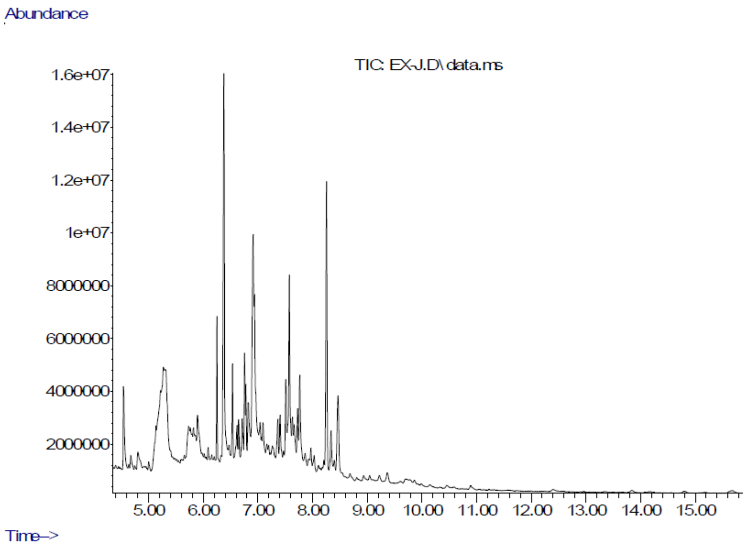


**Fig2: GC-Mass Spectrum of the methanolic extract of *Ricinus communis***

**DISCUSSION:**

Analysis outcome of flavonoids and saponins presence in Ricinus communis is comparable to that reported by various authors, using a thin-layer and preparative chromatography analysis.The two toxic alkaloids produced by these major metabolites are sanguinarine and dihydrosanguinarine. Furthermore, main Ricinus communis constituents reported are rutin, gentisic acid, quercetine, gallic acid, kaempferol 3-O-betarutinoside, tannins, ricin A, B and C.[20]

**CONCLUSION:**

The present study reveals the major pharmacognostic properties of *Riccinus*. GC-MS profiling of *Ricinus communis* roots and ash content reveals the amount of inorganic matter present in the crude drug. The phytochemical analysis of *Ricinus communis* allowed the actual identification of the main secondary metabolites synthesized in roots of the plants using standardized methods.

Therefore, the present work can serve as a source of information for the standardization of the crude drug and a valuable tool for the identification of adulteration.

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