

## References:

1. Saggam, A., Kale, P., Shengule, S., Patil, D., Gautam, M., Tillu, G., Joshi, K., Gairola, S., Patwardhan, B., 2022. Ayurveda-based Botanicals as Therapeutic Adjuvants in Paclitaxel-induced Myelosuppression. *Front. Pharmacol.* 13, 1–12. DOI: <https://doi.org/10.3389/fphar.2022.835616>
2. Diwanay, S., Chitre, D., Patwardhan, B., 2004. Immunoprotection by Botanical Drugs in Cancer Chemotherapy. *J. Ethnopharmacol.* 90, 49–55. DOI: <https://doi.org/https://doi.org/10.1016/j.jep.2003.09.023>
3. Gautam, M., Saha, S., Bani, S., Kaul, A., Mishra, S., Patil, D., Satti, N., Suri, K., Gairola, S., Suresh, K., Jadhav, S., Qazi, G., Patwardhan, B., 2009. Immunomodulatory Activity of Asparagus racemosus on Systemic Th1/Th2 Immunity: Implications for Immunoadjuvant Potential. *J. Ethnopharmacol.* 121, 241–7. DOI: <https://doi.org/10.1016/j.jep.2008.10.028>
4. Gautam, M., Diwanay, S., Gairola, S., Shinde, Y., Patki, P., Patwardhan, B., 2004. Immunoadjuvant Potential of Asparagus racemosus Aqueous Extract in Experimental System. *J. Ethnopharmacol.* 91, 251–5. DOI: <https://doi.org/10.1016/j.jep.2003.12.023>

## Phytochemicals of *Asparagus racemosus*

| No. | AR Phytochemicals   | Type of extract  | Analytical methods   | References |
|-----|---|------------------|--|------------|
| 1.  | 8-Methoxy-5,6,4-trihydroxyisoflavone 7-O--D-glucopyranoside | Methanol extract | H NMR, CNMR, IR  | [1]        |
| 2.  | Shatavarin I  | Methanol extract | 1D NMR, 2D NMR, LCMS, ESI-HR-MS, HSQC, 2D ROESY, 1D TOCSY, HMBC, HPLC                          | [2,3]      |
| 3.  | Shatavarin IV   | Methanol extract | 1D NMR, 2D NMR, LCMS, ESI-HR-MS, HSQC, 2D ROESY, 1D TOCSY, HMBC, HPLC                          | [2–5]      |
|     |   | Water extract    | HPLC/ESI-MS/MS   | [6]        |
| 4.  | Shatavarin V  | Methanol extract | 1D NMR, 2D NMR, LCMS, ESI-HR-MS, HSQC, 2D ROESY, 1D TOCSY, HMBC, HPLC, HPCPC, HPLC-Q-TOF-MS/MS | [2,3,5,7]  |
| 5.  | Shatavarin VI   | Methanol extract | 1D NMR, 2D NMR,  | [2,3,7]    |

| No. | AR Phytochemicals | Type of extract  | Analytical methods  | References |
|-----|-------------------|------------------|---|------------|
| 6.  | Shatavarin VII    | Methanol extract | LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D<br>TOCSY, HMBC,<br>HPLC, HPCPC   |            |
| 7.  | Shatavarin VIII   | Methanol extract | 1D NMR, 2D NMR,<br>LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D [2,3]<br>TOCSY, HMBC,<br>HPLC                                 |            |
| 8.  | Shatavarin IX     | Methanol extract | 1D NMR, 2D NMR,<br>LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D [2,3,5,7]<br>TOCSY, HMBC,<br>HPLC, HPCPC,<br>HPLC-Q-TOF-MS/MS |            |
| 9.  | Shatavarin X      | Methanol extract | 1D NMR, 2D NMR,<br>LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D [2,3]<br>TOCSY, HMBC,<br>HPLC                                 |            |
| 10. | Asparanin A       | Methanol extract | 1D NMR, 2D NMR,<br>LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D [2,3,5,7]<br>TOCSY, HMBC,<br>HPLC, HPCPC,<br>HPLC-Q-TOF-MS/MS |            |
| 11. | Immunoside        | Methanol extract | 1D NMR, 2D NMR,<br>LCMS, ESI-HR-MS,<br>HSQC, 2D ROESY, 1D [2,3]<br>TOCSY, HMBC,<br>HPLC                                 |            |
| 12. | Shatavaroside A   | Methanol extract | HR-ESI-QTOF-MS, C<br>NMR, H NMR, DEPT, [8]<br>HMQC, HMBC  |            |

| No. | AR Phytochemicals  | Type of extract       | Analytical methods   | References |
|-----|--|-----------------------|--|------------|
| 13. | Shatavaroside B<br><br>(1S,2R,3S,8S,9S,10S,13S<br>,14S,16S,17R,22R,25R)-   | Methanol extract      | HR-ESI-QTOF-MS, C<br>NMR, H NMR, DEPT,<br>HMQC, HMBC   | [8]        |
| 14. | 21-nor-18,27- dimethyl-<br>1,2,3-trihydroxy-25-<br>spirost-4-en-19-oic acid  | Ethyl acetate extract | C NMR, H NMR, H-H<br>COSY, HMBC,<br>HPTLC  | [9]        |
| 15. | Shatavaroside C  | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC   | [4]        |
| 16. | Shatavarol   | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC   | [4]        |
| 17. | Racemoside A   | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC,<br>ESI-TOF, DEPT,<br>TOCSY, DQF-COSY,<br>HMQC, 2D COSY | [4,10]     |
| 18. | $\beta$ -sitosterol  | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC   | [4]        |
| 19. | Stigmasterol   | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC   | [4]        |
| 20. | Ursolic acid   | Methanol extract      | ESI-QTOF-MS/MS,<br>HMBC, C NMR, H<br>NMR, GC-MS, TLC   | [4]        |
| 21. | Chelidonic acid  | Methanol extract      | UHPLC-QTOF/MS,<br>LC-MS/MS   | [11]       |
| 22. | 3-<br>O-[ $\beta$ -DGlcopyranosyl<br>(1<br>→2)- $\beta$ -<br>Dglucopyranosyl]-<br>(25S)-5 $\beta$ -spirostan-3 $\beta$ -ol | Methanol extract      | UHPLC-QTOF/MS,<br>LC-MS/MS   | [11]       |
| 23. | $\beta$ -SitosterylD-<br>glucoside6'-palmitate   | Methanol extract      | UHPLC-QTOF/MS,<br>LC-MS/MS   | [11]       |

| No. | AR Phytochemicals  | Type of extract   | Analytical methods  | References |
|-----|--|-------------------|---|------------|
| 24. | Asparanin B5   | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 25. | Aspafiloside C   | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 26. | Pseudo-protodioscin  | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 27. | Asparanin B9   | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 28. | Asparanin B8   | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 29. | Asparaside A<br><br>1,2-Dithiolan-4-<br>carboxylic<br>acid 6-<br>D- $\alpha$ / $\beta$ glucopyranose ester | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 30. | Protodioscin   | Methanol extract  | UHPLC-QTOF/MS,<br>LC-MS/MS  | [11]       |
| 31. | Asparacoside   | Ethanolic extract | HPCPC, HPLC-Q-<br>TOF-MS/MS   | [5,7]      |
| 32. | Racemoside B   | Methanol extract  | ESI-TOF, C NMR,<br>DEPT, H NMR,<br>TOCSY, DQF-COSY,<br>HMQC, HMBC, 2D<br>COSY | [10]       |
| 33. | Racemoside C   | Methanol extract  | ESI-TOF, C NMR,<br>DEPT, H NMR,<br>TOCSY, DQF-COSY,<br>HMQC, HMBC, 2D<br>COSY | [10]       |
| 34. | Asparacosin A  | Methanol extract  | 2D NMR, HR-MS   | [12]       |
| 35. | Schidigerasaponin D5   | Methanol extract  | ESI-TOF, C NMR,<br>DEPT, H NMR,<br>TOCSY, DQF-COSY,<br>HMQC, HMBC, 2D<br>COSY | [10]       |

References:

1. Saxena VK, Chourasia S. A new isoflavone from the roots of *Asparagus racemosus*. *Fitoterapia* 2001;72:307–9. [https://doi.org/10.1016/S0367-326X\(00\)00315-4](https://doi.org/10.1016/S0367-326X(00)00315-4).
2. Hayes PY, Jahidin AH, Lehmann R, Penman K, Kitching W, De Voss JJ. Steroidal saponins from the roots of *Asparagus racemosus*. *Phytochemistry* 2008;69:796–804. <https://doi.org/10.1016/j.phytochem.2007.09.001>.
3. Kumeta Y, Maruyama T, Wakana D, Kamakura H, Goda Y. Chemical analysis reveals the botanical origin of shatavari products and confirms the absence of alkaloid asparagamine A in *Asparagus racemosus*. *J Nat Med* 2013;67:168–73. <https://doi.org/10.1007/s11418-012-0669-4>.
4. Sharma U, Kumar N, Singh B. Furostanol saponin and diphenylpentenol from the roots of *Asparagus racemosus*. *Nat Prod Commun* 2012;7:995–8.
5. Onlom C, Nuengchamnong N, Phrompittayarat W, Putalun W, Waranuch N, Ingkaninan K. Quantification of Saponins in *Asparagus racemosus* by HPLC-Q-TOF-MS/MS. *Nat Prod Commun* 2017;12:7–10.
6. Patil D, Gautam M, Gairola S, Jadhav S, Patwardhan B. HPLC/tandem mass spectrometric studies on steroid saponins: an example of quantitative determination of Shatavarin IV from dietary supplements containing *Asparagus racemosus*. *J AOAC Int* 2014;97:1497–502.
7. Onlom C, Yang Y, Aisa HA, Woranuch N, Phrompittayarat W, Putalun W, et al. Preparative and Rapid Purification of Saponins from *Asparagus racemosus* Root by High Performance Centrifugal Partition Chromatography. *Nat Prod Commun* 2017;12:241–4.
8. Sharma U, Saini R, Kumar N, Singh B. Steroidal saponins from *Asparagus racemosus*. *Chem Pharm Bull (Tokyo)* 2009;57:890–3.
9. Sharma P, Chauhan PS, Dutt P, Amina M, Suri KA, Gupta BD, et al. A unique immunostimulant steroid sapogenin acid from the roots of *Asparagus racemosus*. *Steroids* 2011;76:358–64. <https://doi.org/10.1016/j.steroids.2010.12.006>.
10. Mandal D, Banerjee S, Mondal NB, Chakravarty AK, Sahu NP. Steroidal saponins from the fruits of *Asparagus racemosus*. *Phytochemistry* 2006;67:1316–21. <https://doi.org/10.1016/j.phytochem.2006.04.005>.
11. Jaiswal Y, Liang Z, Ho A, Chen H, Zhao Z. A comparative tissue-specific metabolite analysis and determination of protodioscin content in *Asparagus* species used in traditional Chinese medicine and Ayurveda by use of laser microdissection, UHPLC-QTOF/MS and LC-MS/MS. *Phytochem Anal* 2014;25:514–28. <https://doi.org/10.1002/pca.2522>.
12. Quang DN, Nanthalath P, Khamko VA, Soulinhong X, Vidavone V. Acemosin- a cytotoxic 20-norsteroid from *Asparagus racemosus*. *Fitoterapia* 2018;131:221–4. <https://doi.org/10.1016/j.fitote.2018.11.002>.