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| --- | --- | --- | --- | --- | --- | --- |
| **Table S3. Known terpenes and terpenoids of chaga and their purification/identification** | | | | | | |
| **Terpenoid** | **Molecular formula** | **Extraction Method** | **Qualification Method** | **Purification Method** | **Production regions** | **Reference** |
| Lanosterol/  lanosta-8,24-dien-3β-ol a | C30H50O | Methanol, six times | MS and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column/HPLC/Sephadex LH-20 column | America | Kim et al. (2011) |
| β-Sitosterol/  24R-ethylcholesta-5-en-3β-ol I | C29H50O |
| 3β-Hydroxylanosta-8,24-dien-21-al a | C30H48O2 |
| Ergosterol peroxide/  5,8-epidioxyergosta-6,22-dien-3β-ol b | C28H44O3 |
| Inotodiol/  Lanost-8,24-dien-3β,22R-diol a | C30H50O2 |
| Trametenolic acid/  3β-hydroxylanosta-8,24-dien-21-oic acid a | C30H48O3 |
| Betulin d | C30H50O2 |
| Betulin-3-O-caffeate d | C39H56O5 | Dichloromethane, 48 h, reflux | MS and 1H-NMR/13C-NMR | Silica gel column, HPLC (C18 column) | Norway | Wold et al. (2020) |
| Lanosta-7,9(11),24-trien-3β,22-diol a | C30H50O3 | n-Hexane | IR spectra, MS, and 1H-NMR/13C-NMR | Alumina column | Unknown | Kahlos et al. (1986) |
| Lanosta-8,23E-dien-3β,22R,25-triol/  3β,22R,25-trihydroxylanosta-8,23E-diene a | C30H50O3 | Chloroform, 20 days, 60℃, | IR spectra, MS, and 1H-NMR/13C-NMR | Silica gel column and MPLC/HPLC | Cultured chaga from Japan | Taji et al. (2008b) |
| Lanosta-7,9(11),23E-trien-3β,22R,25-triol/  3β,22,25-trihydroxylanosta-7,9(11),23E-triene a | C30H48O3 |
| Lanosta-8,24-dien-3β,21-diol/  3β,21-dihydroxylanosta-8,24-diene/uvariol/  21-hydroxylanosterol a | C30H50O2 |
| Inonotusol A/  (−)-(3R,5S,10S,11R,15S,17R,20R,21S,24S)-21,24-cyclopenta-3,11,15,21,25-pentahydroxylanosta-8-en-7-one a | C30H48O6 | 95% Ethanol,2 h, three times | IR spectra, MS, and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column, HPLC (C18 column) | China | Liu et al. (2014) |
| Inonotusol B/  (−)-(3R,5S,10S,11R,15S,17S,20R,21S,24R)-21,24-cyclopenta-3,11,15,21,25-pentahydroxylanosta-8-en-7-one a | C30H48O6 |
| Inonotusol C/  (17α,20β,24α)-21,24-cyclopenta1α,3β,21α,25,28-pentahydroxy-5α-lanosta-7,9(11)-diene a | C30H48O5 |
| Inonotusol D/  (17β,20β,24β)-21,24- cyclopenta-1α,3β,21α,25,28-pentahydroxy-5α-lanosta-7,9(11)- diene a | C30H48O5 |
| Inonotusol E/  (−)-(3R,5S,10S,11R,17S,20R,21S,24R)-21,24-cyclopenta-3,11,21,25-tetrahydroxylanosta-8-en-7-one a | C30H48O5 |
| Inonotusol F/  (17α,21α,23α)-24-methyl-3β-hydroxy-5α-lanosta-8,24-dien-21,23-lactone a | C31H48O3 |
| Inonotusol G/  3β,22-dihydroxy-5α-lanosta-8,25-dien-24-one a | C30H48O3 |
| Inonotusic acid/  (−)-(5S,10S)-13-isopropyl-7-oxo-abieta-8,11,13-trien-20-oic acid e | C21H28O2 |
| 3β,22-Dihydroxylanosta-8,24-dien-7-one a | C30H48O3 |
| Ergosta-7,22-dien-3β-ol b | C28H46O |
| Lawsaritol/  stigmast-4-en-3β-ol i | C29H50O |
| Fungisterol/  ergosta-7-en-3β-ol b | C28H48O |
| Ergone/  ergosta-4,6,8(14),22-tetraen-3-one b | C28H40O |
| Ergosterol b | C28H44O |
| inonotusol I | C30H48O4 | 95% Ethanol 12 h, four times | MS, and 1H-NMR/13C-NMR | Silica gel column, Sephadex LH-20, semipreparative HPLC | China | Kou et al. (2021) |
| inonotusal H | C30H48O6 |
| inonotusol J | C30H48O5 |
| inonotusol K | C30H48O6 |
| inonotusol L | C30H48O5 |
| inonotusol M | C30H48O6 |
| inonotusol N | C30H48O5 |
| (3S,8E)-3-hydroxy-β-damascone | C13H20O2 | 70% ethyl alcohol (EtOH), for 2 h at 70 ◦C for three times | LC, MS, ECD, MS, 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel and octadecylsilyl silica gel column, semipreparative HPLC (YMC C18 column), HP-20 macroporous resin | Russia | Chang et al. (2022) |
| 6-hydroxy-4,7-megastigmadiene-3,9-dione | C13H22O |
| grasshopper ketone | C13H20O3 |
| 3β-Hydroxylanosta-8,24-dien-21,23-lactone a | C30H46O3 | 95% Ethanol, 24 h, RT, 5 times | MS and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column | Japan | Shin et al. (2000) |
| Methyl trametenolate a | C31H50O3 | - | - | - |
| 21,24-Cyclopentalanosta-8-en-3β,21,25-triol a | C30H50O3 | 95% Ethanol, 24 h, RT, 5 times | MS and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column | Japan | Shin et al. (2001b) |
| Lanosta-8-en-3β,22,25-triol a | C30H52O3 | 95% Ethanol, 24 h, RT, 5 times | MS and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column | Japan | Shin et al. (2002) |
| Inonotsutriol D/  lanosta-8-en-3β,22R,24R-triol a | C30H50O3 | Chloroform, 7 days, 50℃, | IR spectra, MS, and 1H-NMR/13C-NMR | Silica gel column and MPLC (silica gel column)/HPLC (C18 column) | Cultured chaga from Japan | Tanaka et al. (2011) |
| Inonotsutriol E/  lanosta-8-en-3β,22R,24S-triol a | C30H50O3 |
| Oleanolic acid c | C30H48O3 | 95% Ethanol, 1 h, reflux, 5 times | IR spectra, MS, and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column, Sephadex LH-20 and HPLC (C18 column) | China | Zhao et al. (2015a) |
| Betulinic acid d | C30H48O3 |
| Inonotusane A/  (21S, 24R)-24-cyclolanost-8-en-3β,21,25-triol a | C30H50O3 |
| Inonotusane B/  (21S, 24S)-24-cyclolanost-8-en-3β,21,25-triol a | C30H50O3 |
| Inonotusane C/  3β -hydroxy-4,4,14-trimethylchola-8,22E-dien-24-al o | C27H42O4 |
| Obliquic acid/  3β-hydroxy-25,26,27-trinorlanosta-8,22E-dien-24-oic acid a | C27H42O3 |
| 3β-Hydroxylanosta-7,9(11),24-trien-21-oic acid a | C30H46O3 |
| (+)-Fuscoporianol C/  3β,22α,25-trihydroxylanosta-8,23E-diene a | C30H50O3 |
| Inonotsutriol A/  (20R,21R,24S)-21,24-cyclopentalanosta-8-en-3β,21,25-triol a | C30H50O3 | Chloroform, 20 days, 60℃ | IR spectra, 1H-NMR/13C-NMR, and MS | Silica gel column and MPLC (silica gel column)/HPLC (C18 column) | Cultured chaga from Japan | Taji et al. (2008a) |
| Inonotsutriol B/  (20R,21R,24R)-21,24-cyclopentalanosta-8-en-3β,21,25-triol a | C30H50O3 |
| Inonotsutriol C/  (20R,21R,24S)-21,24-cyclopentalanosta-7,9(11)-dien-3β,21R,25-triol a | C30H48O3 |
| Inonotsulide A/  (20R,24S)-3β,25-dihydroxylanost-8-en-20,24-olide a | C30H48O4 | Chloroform, 20 days, 60℃ | IR spectra, 1H-NMR/13C-NMR, and MS | Silica gel column and MPLC (silica gel column)/HPLC (C18 column) | Cultured chaga from Japan | Taji et al. (2007) |
| Inonotsulide B/  (20R,24R)-3β,25-dihydroxylanost-8-en-20,24-olide a | C30H46O4 |
| Inonotsulide C/  (20R,24S)-3β,25-dihydroxylanosta-7,9(11)- dien-20,24-olide a | C30H46O3 |
| Inonotsuoxide A/  22R,25-epoxylanost-8-en-3β,24S-diol a | C30H50O3 | Chloroform, 7 days, 50℃ | IR spectra, 1H-NMR/13C-NMR, and MS | Silica gel column and MPLC (silica gel column)/HPLC | Cultured chaga from Japan | Nakata et al. (2007) |
| Inonotsuoxide B/  22S,25-epoxylanost-8-en-3β,24S-diol a | C30H50O3 |
| Inotolactone B/  3β-hydroxy-24-methyl-lanosta-8,24(25)-dien-26,22R-olide a | C31H48O3 | 95% Ethanol, 3 days, RT | IR spectra, 1H-NMR/13C-NMR, and MS | Silica gel column and HPLC (C8 column) | Mycelia culture | Ying et al. (2014) |
| Inotolactone A/  3β-hydroxy-24-methyl-lanosta-7,9,24(25)-trien-26,22R-olide a | C31H46O3 |
| Inotolactone C/  3β-hydroxydriman-12,11-olide f | C15H24O3 |
| 6β-Hydroxydriman-12,11-olide f | C15H24O3 |
| 3β-Hydroxycinnamolide f | C15H22O3 |
| 17-Hydroxy-ent-atisan-19-oic acid g | C20H32O3 |
| Saponaceoic acid I/  3β,25-dihydroxy-4,4,14-trimethyl-5α-cholesta-8,23-dien-21-oic acid a | C30H48O4 | 95% Ethanol, 1 h, reflux, 5 times | IR spectra, MS, and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column, Sephadex LH-20 and HPLC (C18 column) | China | Zhao et al. (2016) |
| Ganodecochlearin A/  22R,25-epoxylanost-7,9-dien-3β,24S-diol a | C30H48O3 |
| 9,11-Dehydroergosterol peroxide b | C28H42O3 |
| Inonotusane D/  3β-hydroxy-24,25,26,27-tetranorlanosta-8-en-22-one a | C26H42O2 |
| Inonotusane E/  3β,12β,15α,21R,25-pentahydroxy-21,24S-cyclopentalanosta-7,9(11)-diene a | C30H48O5 |
| Inonotusane G/  lanosta-8-en-3β,22,24,25-tetraol-25-methyl oxide a | C31H54O4 |
| Inonotusane F/Chagabusone A/  3β-hydroxylanosta-8,25-dien-24-on-21-oic acid a | C30H46O4 | 80% Methanol, 2 days, twice, RT | IR spectra, MS, and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column/HPLC (C18 column) | Russia | Baek et al. (2018) |
| Spiroinonotsuoxodiol/  3S,7S-dihydroxy-7(8 →9R) abeo-lanost-24-en-8-one a | C32H52O4 | Chloroform | IR spectra, MS, and 1H-NMR/13C-NMR | Silica gel column, MPLC (silica gel column) and HPLC (C18 column) | Japan | Handa et al. (2010) |
| Inonotsuoxodiol A/  3β,22-dihydroxylanosta-8,24-dien-11-one a | C30H48O3 |
| Inonotsudiol A/  lanosta-8,24-dien-3 β,11β-diol a | C30H50O2 |
| 5,8,22-Ergostatrienol b | C28H44O | Petroleum, 14h, RT | GC-MS | - | Cultivated or wild chaga from China | Sun et al. (2011) |
| 5,7-Ergostadienol b | C28H46O |
| (22E)-Ergosta-8(14),15,22-trien-3-ol | C28H44O | MTBE, Soxhlet extractor, 27h | GC-MS (HP-5 MS sorbent column) | - | Russia | (Shcherbakov et al., 2022) |
| Trametenolic aldehyde | C30H48O2 |
| Ergosta-5,8-dien-3-ol | C28H46O |
| Neoergosterol | C27H40O |
| Eburicol | C31H52O |
| D:C-Friedooleana-7,9(11)-dien-3-ol | C30H50O |
| Lanosta-8,24-dien-3-one | C30H48O |
| Ergostenol | C22H48O |
| Dehydroergosterol | C28H42O |
| 24-Methylene lanostenol |  |
| Squalene | C30H50 |
| Inoterpene A a | C30H52O3 | Methanol, 3h, reflux, 3 times | IR spectra, MS, and 1H-NMR/13C-NMR | Liquid-liquid extraction, silica gel column, and HPLC (C18 column) | Japan | Nakamura et al. (2009) |
| Inoterpene B a | C30H52O3 |
| Inoterpene C a | C30H52O3 |
| Inoterpene D a | C30H50O3 |
| Inoterpene E a | C30H50O4 |
| Inoterpene F a | C30H48O2 |
| (3R,5S,8R,9S,10S,13S,14S,17S)-21-Methylidyne-pregn-3-ol/(3R,5S,8R,9S,10S,13S,14S,17S)-17-(1-hydroxyprop-2-ynyl)-10,13-dimethyl-2,3,4,5,6,7,8,9,11,12,14,15,16,17-tetradecahydro-1H-cyclopent-a[a]phenanthren-3-ol k | C22H33O2 | Chloroform, 12h, RT, three times | UPLC-Q-TOF-MSn | Silica gel column/HPLC (C18 column) | Mycelia Culture | Geng et al. (2013) |
| (2S,4aR,10bR)-1,1,4a,10b-Tetramethyl-1,2,3,4,4a,4b,5, 6,10b,11,12,12a-dodecahydrochrysen-2-ol | C22H31O |
| (5α,20S)-3β,20-Bis-(dimethylamino)-4-(hydroxylmethyl)-4,14-dimethyl-9β,19-cyclopregn-6-en-16α-ol k | C28H47N2O2 |
| (22E)-Stigmasta-7,22,25-trien-3-yl acetate i | C31H47O2 |
| (3β)-Olean-12-en-3-yl-(4-hydroxyphenyl)propanoate c | C39H57O3 |
| Ligudentatol v | C14H18O |
| 24-Methylene dihydrolanosterol a | C31H52O | 80% Ethanol, 24h, RT | GC-MS | - | Farmed chaga and mycelia culture from china | Zheng et al. (2007) |
| 4,4-Dimethyl fecosterol b | C32H50O |
| 4-Methyl fecosterol b | C31H48O |
| Fecosterol/  δ-8(24),28-Ergostadienol b | C30H46O |
| Episterol/  ergosta-7,24(28)-dien-3-ol b | C28H46O |
| Ergosta-5,7,9(11),22-tertraen-3-ol b | C28H42O |
| Ergosta-5,7,9(11),22-tertraen-3-ol benzoate b | C35H46O2 |
| Fuscoporianol D/  3β,22α-dihydroxy-lanosta-8,25(27)-dien-24-peroxide a | C30H50O4 | 80% Ethanol, 24h, RT | GC-MS, 1H-NMR/13C-NMR, X-ray, and IR spectra, | Silica gel column and macroporous resin |
| Fuscoporianol A/  25-methoxy-21, 22-cyclolanosta-8-en-3β,21α-diol a | C31H52O3 | Petroleum ether, reflux | IR spectra, MS and 1H-NMR/13C-NMR | Silica gel column | China | He et al. (2001) |
| Fuscoporianol B/  3β,22α-dihydroxy-lanosta-8,23E-dien-25-peroxide a | C30H50O4 |
| Fuscoporianol C/  3β,22α,25-trihydroxy-lanosta-8,23E-diene a | C30H50O3 |
| Lupeol d | C30H50O | - | GC and GC-MS | - | Unknown | Kahlos et al. (1987);  Kahlos (1994) |
| Lupenone d | C30H48O |
| Stigmastanol/sitostanol i | C29H52O |
| Cholesterol h | C27H46O |
| β-Selinene l | C15H24 | - | GC and GC-MS | - | Unknown | Ayoub et al. (2009) |
| *cis*-Bergamotene n | C15H24 |
| *trans*-Bergamotene n | C15H24 |
| α-Santalene m | C15H24 |
| β-Sesquifenchene | C14H22 |
| epi-β-Santalene m | C15H24 |
| Photosantalol m | C15H24O |
| β-Eudesmol l | C15H26O |
| γ-Eudesmol l | C15H26O |
| p-Cymene t | C10H14 | Hydrodistillation | GC and GC-MS | - | Mycelia culture | Kahlos et al. (1992) |
| α-Bisabolene s | C15H24 |
| δ-Cadinol p | C15H26O |
| (Z)-β-Farnesene r | C15H24 |
| α-Curcumene u | C15H22 |
| α-Cedrene q | C15H24 |
| α-Turmerone u | C15H22O |
| a: lanostane-type triterpenoids and steroids; b: ergostane-type steroids; c: oleanane-type triterpenoids; d: lupane-type triterpenoids; e: abietane-type diterpenoids; f: drimane-type sesquiterpenoids; g: atisane-type diterpenoids; h: cholestane-type steroids; i: stigmastane-type steroids; j: cycloartane-type triterpenoids and steroids; k: pregnane-type steroids; l: eudesmane-type sesquiterpenoids; m: santalane-type sesquiterpenoids; n: bergamotane-type sesquiterpenoids; o: cholane-type triterpenoids; p: cadinane-type sesquiterpenoids; q: cedrane-type sesquiterpenoids; r: farnesane-type sesquiterpenoids; s: bisabolane-type sesquiterpenoids; t: menthane-type monoterpenoid; u: curcumane-type sesquiterpenoids; v: noreudesmane-type sesquiterpenoids | | | | | | |

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