Natural Antifungal Compounds from the Peels of *Ipomoea batatas Lam*

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Abstract

Three antifungal compounds have been isolated for the first time from the peels of *Ipomoea batatas* Lam. Their structures were established on the basis of 1D and 2D NMR spectra data as well as ESI-MS and IR analysis. Urs-13(18)-ene-3β-yl acetate was found to possess a weak activity against *Sporothrix schenckii* and *Trichophyton metagrophytes* fungi with an MIC value of 50 μg/mL each. Stigmasterol and 3-Friedelanol were equally active against *Trichophyton metagrophytes*.

Keywords: Peels, *Ipomoea batatas*, stigmasterol, 3-friedelanol, *Sporothrix schenckii*, *Trichophyton metagrophytes*
Experimental

General experimental procedures: Melting points were determined on a Stuart Melting point Apparatus SMP30 and are uncorrected. IR spectra were measured on an Agilent Cary 630 FTIR Spectrometer.

The $^1$H and $^{13}$C NMR spectra were obtained on a 400 MHz Bruker (Switzerland) and chemical shifts are given in $\delta$ (ppm) with TMS as reference. ESI-MS were obtained on Waters UPLC-TQD Mass spectrometer. Column chromatography (CC) was performed on silica gel (100-200 mesh), thin layer chromatography was performed on a pre-coated silica gel GF$_{254}$ 0.25mm Mark W. Germany.

Plant Material

White skinned variety of sweet potato (*Ipomoea batatas* Lam) was obtained from a local market in Ilorin, Nigeria and identified by a taxonomist at the herbarium of Biological Sciences Department of the University of Ilorin, Ilorin, Nigeria where a voucher specimen number UIH 001/486 was obtained. The peels were carefully removed and air-dried at room temperature. The peels unavoidably contained a little of the sweet potato tissue.

Extraction and isolation

The dried peels (1.7Kg) of the white skinned variety of *Ipomoea batatas* Lam was percolated with 95% (5 x 5L) at room temperature. The extract was concentrated each time with the aid of a rotary evaporator at about 50°C. The ethanolic extract was sonicated in n-hexane to obtain the hexane fraction. The solution was concentrated to give a residue (36.6g). This was separated over silica gel into 3 fractions F002 a, b and c. F002a (10.57g) was separated by silica gel cc using n-hexane/EtOAc (1:0 → 0:1, v/v), as eluent affording 9 fraction combinations. Fractions 9-25 afforded compound I (30mg), fractions 66-73 yielded compound III (4.5mg) while repeated column chromatography of fractions 79-113 (1.855g) yielded compound II (15mg).
Urs-13(18)-ene-3β-yl acetate (I)

Mp: 239-241°C IR (KBr) \( \nu_{\text{max}} \): 3019.29, 2957.25, 1723.41, 1523.21 cm\(^{-1} \) ESI-MS: 492.3 (M+Na)\(^+ \) HR-ESIMS: 469.3378; HNMR (CDCl\(_3\)): 0.7845 (3H, s, H-28), 0.8546 (3H, s, H-23), 0.8644 (3H, s, H-24), 0.8866 - 0.9032 (3H, d, J=6 Hz, H-29), 0.9310 - 0.9475(3H, d, J=6 Hz, H-30), 0.9520(3H, s, H-25), 0.9973 (3H, s, H-26), 1.0540 (3H, s, H-27), 4.4813-4.5234(1H, dd, J=5.4,11.5 Hz, H-3). For the Carbon-13 spectra, see table S1.

Stigmasterol (II)

Mp: 134-135°C IR (KBr) \( \nu_{\text{max}} \): 3399.86, 3019.69, 1650, 1215.69, 1068.84cm\(^{-1} \); ESI-MS: 413 (M+H)\(^+ \) HR-ESIMS: 413.2731(M+H)\(^+ \); HNMR (CDCl\(_3\)) : 0.7057(3H, s, H-29), 0.7239(3H, s, H-18), 0.8304(3H, s, H-27), 0.8634(3H, s, H-26), 1.0348 (3H, s, H-19), 1.0549(3H, d, J=8.0 Hz, H-21), 3.5481 (1H, m, J= 4.4, 6.5,4.7Hz, H-3), 5.0129-5.0346 (1H, dd, J=8.5, 6.6Hz, H-23), 5.1504-5.2097(1H, dd, J=8.5, 6.6Hz, H-22), 5.3690-5.3819(1H, dd, J=5.1Hz, H-6). For carbon 13 spectra data, see table S1.

3-Friedelanol (III)

Mp: 276°C IR (KBr) \( \nu_{\text{max}} \): 3398.97, 3019.73, 1215.77, 1088.78 cm\(^{-1} \) ESI-MS: [M-H\(_2\)O+H]\(^+ \) at 411 m/z HR ESIMS: 429.1858; HNMR (CDCl\(_3\)) : 0.8564 (3H, s, H-27), 0.9250 (3H, s, H-28), 0.9425 (3H, s, H-26), 0.9618(3H, s, H-24), 0.9881(3H, s, H-25), 0.9919 (3H, s, H-29), 0.9919-1.0030 (3H, d, J=4.4Hz, H-23), 1.1672 (3H, s, H-30), 1.9(2H, m, H-2), 3.72 (1H, m, H-3). For carbon 13 spectra data, see table S1.

Antimicrobial Activity

Fungi were tested by NCCLS method in RPMI 1640 medium (2002) and bacteria in Mueller Hinton Broth against 1. *E. coli* (ATCC 9637), 2. *Pseudomonas aeruginosa* (ATCC BAA-427), 3. *Staphylococcus aureus* (ATCC 25923), 4. *Klebsiella pneumoniae* (ATCC 27736). 5. *Candida albicans* 6. *Cryptococcus neoformans* 7. *Sporothrix schenckii*, 8. *Trichophyton mentagrophytes*, 9. *Aspergillus fumigatus* 10. *Candida parapsilosis* (ATCC-22019).
| Carbon | I  | II  | III |
|-------|----|-----|-----|
| 1     | 30.76 | 37.27 | 35.34 |
| 2     | 25.72 | 28.92 | 35.56 |
| 3     | 81.48 | 71.82 | 72.76 |
| 4     | 37.43 | 42.33 | 53.2 |
| 5     | 48.59 | 140.77 | 39.68 |
| 6     | 19.22 | 121.72 | 41.73 |
| 7     | 35.23 | 31.92 | 17.55 |
| 8     | 43.17 | 31.69 | 49.18 |
| 9     | 46.69 | 50.16 | 37.84 |
| 10    | 38.58 | 36.52 | 61.36 |
| 11    | 23.01 | 24.37 | 15.79 |
| 12    | 27.97 | 23.09 | 30.64 |
| 13    | 131.49 | 39.7 | 38.38 |
| 14    | 41.77 | 56.78 | 37.11 |
| 15    | 38.87 | 25.41 | 36.09 |
| 16    | 33.3 | 28.25 | 32.34 |
| 17    | 42.92 | 55.98 | 29.71 |
| 18    | 142.23 | 12.25 | 42.83 |
| 19    | 59.46 | 12.06 | 32.82 |
| 20    | 30.2 | 40.48 | 30.03 |
| 21    | 26.85 | 19.4 | 32.34 |
| 22    | 26.79 | 138.31 | 39.28 |
| 23    | 17.56 | 129.29 | 18.64 |
| 24    | 29.33 | 51.24 | 16.39 |
| 25    | 23.28 | 29.12 | 20.12 |
| 26    | 26.06 | 19.82 | 11.62 |
| 27    | 27.09 | 19.04 | 18.24 |
| 28    | 18.29 | 21.09 | 35.19 |
| 29    | 23.45 | 11.87 | 31.79 |
| 30    | 23.33 | 32.09 |  |
| ÇOOC  | 171.51 |  |
| ÇH₃ÇOO | 21.69 |  |

Table S1: $^{13}$C Assignments for Compounds I-III
Figure S1: Biosynthetic Pathway for Compounds I-III (Jenner, 2005; Jacinda and Ian, 2009)
| Code No.   | Minimum inhibitory conc. (MIC) in μg/ml against |   |   |   |   |   |   |   |   |
|-----------|----------------------------------------------|---|---|---|---|---|---|---|---|
|           | **BACTERIA**                                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Compound I | >50                                          | >50 | >50 | >50 | >50 | 50 | 50 | >50 | >50 |
| Compound II | >50                                          | >50 | >50 | >50 | >50 | 50 | 50 | >50 | >50 |
| Compound III | >50                                          | >50 | >50 | >50 | >50 | 50 | 50 | >50 | >50 |
| Gentamycin | **3.12**                                      | **0.78** | **0.78** | **1.56** | ND | ND | ND | ND | ND |
| Norfloxacin | **0.048**                                     | **1.56** | **0.78** | **0.19** | ND | ND | ND | ND | ND |
| Fluconazole | ND                                           | ND | ND | ND | 1 | 2 | 2 | >32 | >32 |
| Amphotericin-B | ND                                         | ND | ND | ND | 0.016 | 0.125 | 0.25 | 0.25 | 0.5 | 0.016 |

Table S2: Antifungal Activity of Compounds I-III

S1: HNMR Spectra of Compound I (Urs-13(18)-ene-3β-yl acetate)
S2: COSY Spectra of Compound I (Urs-13(18)-ene-3β-yI acetate)

S3: HSQC Spectra of Compound 1
S4: HMBC Spectra of Compound I

S5: TOCSY Spectra of Compound I
S6: HNMR Spectra of Compound II (Stigmasterol)

S7: COSY spectra of Compound II (Stigmasterol)
S8: HNMR Spectra of Compound III (3-Friedelanol)

S9: COSY Spectra of Compound III (3-Friedelanol)