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SHORT COMMUNICATION

Natural antifungal compounds from the peels of *Ipomoea batatas* Lam

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ABSTRACT

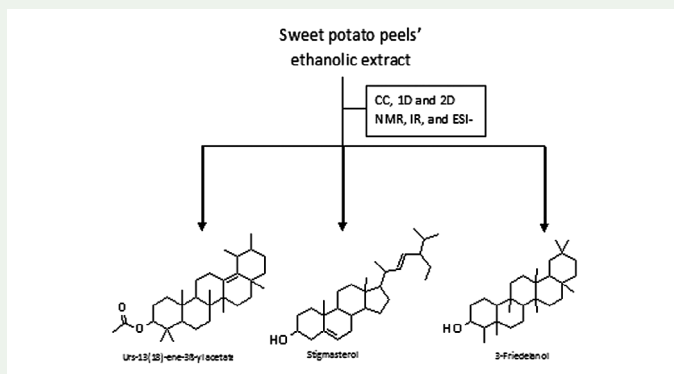
Three antifungal compounds have been isolated for the first time from the peels of *Ipomoea batatas* Lam. Their structures were established on the basis of 1D and 2D NMR spectra data as well as ESI-MS and IR analysis. Urs-13(18)-ene-3 β -yl acetate was found to possess a weak activity against *Sporothrix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

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1. Introduction

Sweet potato (*Ipomoea batatas* Lam) is a member of the Convolvulaceae family and it is the seventh most important crop worldwide. It is widely grown around the world due to its hardy nature and its important folkloric applications, especially in China and amongst other nations (Li 1999; Andrade et al. 2009). Several compounds such as batatins (Edgar & Rogelio 2007), aminoacyl sugars (Irene et al. 2006), coumarins (Yuan et al. 2005), triterpenoids (Luo & Kong 2005) and esters of caffeic and coumaric acids (Muyinza et al. 2010) have been earlier

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isolated from the aerial parts and tubers of the plant. Other phytochemicals which have been sourced from the plant include anthocyanins (Van-den et al. 2010; Xinying et al. 2013) and from *Ipomoea obscura* which is also from the Convolvulaceae family, sesquiterpene-rich essential oil (Rajesh 2015).

Conducting a study on a Nigerian variety of sweet potato is important considering the fact that ecological factors play a major role in the kind of phytochemicals that are biosynthesised in plants. Furthermore, it is also suspected that the peel might contain significant and medicinally important phytochemicals that are not obtainable in the flesh (Ogundana et al. 1983).

In our previous study (Oluyori et al. 2013), we reported the isolation of an alkyl resin from the peels of the plant. Further investigation into the peels of this plant has led to the isolation of three known compounds which are being reported for the first time from the peels of *I. Batatas* Lam and which exhibited undocumented biological activity.

2. Results and discussion

Compound I (0.082% of the n-hexane fraction) was obtained as a crystalline compound with melting point 239–241 °C. Positive result from Liebermann-Burchard test indicated that I was a triterpenoid. The compound showed a characteristic TLC pink spot peculiar to triperpenoids (R_f value 0.49, EtOAc/n-hexane 1:50) after the developed plate was dipped in a saturated solution of $\text{Ce}(\text{SO}_4)_2$ in 65% H_2SO_4 and heated to 110 °C. The molecular formula of I, $\text{C}_{32}\text{H}_{52}\text{O}_2$ was determined from the ESI-MS ($\text{M}^+ + \text{Na}$) at 492.3 (calcd for 469.3378 ESI-HRMS). The ^1H NMR spectrum of I exhibited a hump between 0.5 and 2.2 ppm which is peculiar to steroids and triterpenoids. The signals at δ 4.4813–4.5224 (dd, $J = 5.4$ Hz, 11.5 Hz) is the characteristic of H-3 of a pentacyclic triterpenoid skeleton. In addition, the proton NMR revealed the presence of six CH_3 singlets at δ 0.7845, 0.8546, 0.8644, 0.9475, 0.9973 and 1.0500 (each 3H, s) along with two secondary methyls; δ 0.8866–0.9032 (3H, d, $J = 6.6$ Hz) and δ 0.9300–0.9475 (3H, d, $J = 6.6$ Hz). The ^{13}C NMR (Table S1) and DEPT spectra displayed 32 carbon atoms including 8 quaternary, 8 methyl, 10 methylene and 5 methine protons. Two of the quaternary carbons were olefinic carbons (131.49 and 142.23). Based on the data above, HSQC, COSY, HMBC spectra, as well as comparison with literature (Niaz 2013), the structure of I is identified as urs-13(18)-ene-3 β -yl acetate (Figure 1). This compound is an isomer of the well-known compound alpha amyirin acetate and its occurrence is reported from this plant family for the first time. It has been reported that alpha amyirin acetate has antispasmodic activity amongst other properties (Niaz 2013).

Compound II (0.041% of the n-hexane fraction) was obtained as needle-shaped transparent crystals, melting point 134–135 °C. Positive result for Liebermann-Burchard test indicated that II was a steroid. This molecule showed a purple spot (R_f value 0.36 in 20% EtOAc in n-hexane) after the developed plate was dipped in a saturated solution of $\text{Ce}(\text{SO}_4)_2$ in 65% H_2SO_4 and heated on a hot plate at about 110 °C. The molecular formula of II was determined to be $\text{C}_{29}\text{H}_{48}\text{O}$ from the ESI-MS M^+ at 412, $\text{M}^+ + \text{H}$ at 413]. HRMS: 413.2731 ($\text{M} + \text{H}$) $^+$. The features contained in the ^1H NMR, ^{13}C (Table S1), DEPT spectra of II were compared well with reported data (Anjoo & Ajay 2011), and thus II was identified as Stigmasterol, a well-known compound (Figure 1). The economic importance of stigmasterol stems from its use as a precursor in the production of semi-synthetic progesterone and cortisone. The compound has also been reported to possess antiosteopathic, antioxidant, antihypercholesterolemic, antitumour,

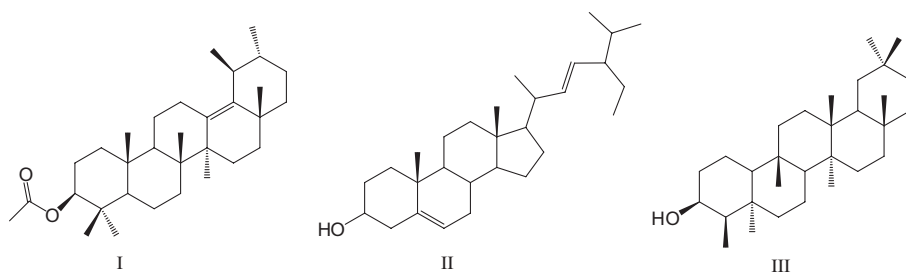


Figure 1. Compounds I–III.

hypoglycaemic and thyroid inhibitory potential (Navpreet et al. 2011). This further explains the reason why this stigmasterol, has been shown as a constituent of several crude plant extracts of biological importance by various researchers.

Compound III (0.012% of the n-hexane fraction) was obtained as white crystals, melting point 276 °C, $R_f = 4.3$ (10% EtOAc in n-hexane) ESI-MS data show $[M + H - H_2O]^+ @ 411$. Molecular formula is $C_{30}H_{52}O$. Comparing the ^1H NMR, ^{13}C (Table S1) and DEPT spectra of III with literature (Trinh et al. 2007), the structure of III was identified as 3-friedelanol (Figure 1). 3-Friedelanol is an antitumour compound (Kundu et al. 2000) and is useful in the preparation of dietary supplements or cosmetics that modulate ageing-associated diseases (Yang et al. 2011).

As shown in Table S2, urs-13(18)-ene-3β-yl acetate showed a weak activity against *Sporothrix schenckii* and *Trichophyton metagrophytes* with an MIC value of 50 µg/mL, while stigmasterol and 3-friedelanol showed similar activity against only *T. metagrophytes* (MIC 50 µg/mL). These compounds are probably biosynthesised by the plant to help provide resistance against some microbial infections. In the antifungal study of α and β amyrin derivatives carried out by Johann et al. (2007) against *Candida* species, the most active of the derivatives were the formate and the acetate derivatives with MIC values between 30 and 250 µg/mL. The MIC value of urs-13(18)-ene-3β-yl acetate falls within this range thus confirming its antifungal potential.

The biosynthesis of triterpenoids occurs via isoprenoid pathway. Isopentyl diphosphate (IPP) and dimethylallyl diphosphate (DMAPP) are converted into farnesyl diphosphate by the enzyme farnesyl diphosphate synthase (FPS). FPS is then converted to squalene by squalene synthase (SQS). Squalene epoxidase oxidises squalene to 2,3-oxidosqualene which is afterwards cyclised by oxidosqualene cyclase through different intermediates to obtain different types of triterpenes/sterols (Figure S1) (Jenner et al 2005; Jacinda & Ian 2009).

Although triterpenoids/sterols are economically important, their synthesis remains an uncompetitive option because of their structural complexity. Plant tissue culture therefore becomes a wise means of enhancing the yield of these biologically active compounds. The peel of sweet potato could be used as an explant for the development of a plant with better yields of compounds I–III.

A potential method of enhancing triterpene synthesis is to increase the flux of IPP and DMAPP by overexpressing their genes (Jacinda & Ian 2009). In a recent study, overexpression of SQS gene in *Panax ginseng* resulted in hyperproduction of triterpenes and phytosterols (Lee et al. 2004). This method could be adopted in order to conveniently increase the bio-availability of the antifungal triterpenes/steroids which naturally occur in the peels of *I.*

batatas Lam. For example, specifically increasing α -amyrin synthase, a triterpene synthase, should ultimately lead to an increased yield of urs-13(18)-ene-3 β -yl acetate (Compound I).

3. Conclusion

Peels which are generated as waste from sweet potato during domestic and commercial processing contains phytochemicals which can be used to ameliorate skin infections. The yield of these compounds can be enhanced by the cloning of genes in their biosynthetic pathways.

Supplementary material

Experimental details relating to this paper are available online along with relevant spectra, tables S1 and S2.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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