Identification of a New Antifungal Oligoacetal Derivative Produced by Streptomyces toxytricini Against Candida albicans

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Abstract
Thirty actinomycete isolates were isolated from soil and tested against Candida albicans in-vitro. The active isolate was identified by 16s-rRNA gene sequencing method as Streptomyces toxytricini. The antifungal compound was extracted with ethyl acetate followed by di-ethyl ether. Both HPLC and GC-MS analysis confirmed presence of one pure compound in the diethyl ether extract. The compound is a yellow liquid has a maximum absorbance at 240nm. in methanol. The chemical structure was elucidated by 1D and 2D-NMR and IR analysis. The elucidated molecular formula was C_{36}H_{54}O_{14}. The compound is a polyacetal tricyclononane derivative, composed of a tricyclononane ring attached from the carbon atom number four with an oligoacetal chain (six acetal groups in chain) and from the carbon atom number seven with a methoxy carbonyl benzene-1,3-dicarboxylic acid. The purposed name is: 4- { [tricycle(3.2.1.1^{13})non-8-yl] methoxy carbonyl benzene-1,3-dicarboxylic acid } (2,4,5,6,7, 8, 9 heptaoxa, 3-ethoxy, 5,6,7,9- tetramethyl unidecane).

Keywords: Antifungal, Streptomyces toxytricini, Candida albicans, tricyclononane.
Table S1. The chemical shift values for H$^1$, C$^{13}$, COSY and HMBC NMR data analysis:

| C No. | σ C     | σ H     | Assignment | COSY     | HMBC   | σ H $\rightarrow$ σ C |
|-------|---------|---------|------------|----------|--------|------------------------|
| 1     | 18.5    | 1.28 (t,7 ) | CH$_3$     | 3.59, 3.89 | 64.6   |                        |
| 2     | 64.6    | 3.59 (m) 3.89 (m) | CH$_2$     | 1.28     | 18.5, 105.05 |                        |
| 3     | 105.05  | 4.95 (q, 5.5) | CH         | 1.28     | 64.6   |                        |
| 4     | 105.05  | 5.07 (d)   | CH         | 1.31     | 18.38, 105.05, 105.18 |                        |
| 5     | 105.18  | 5.38 (q, 5.4) | CH         | 1.33     | 105.05 |                        |
| 6     | 103     | 5.23(q, 5.4) | CH         | 1.33     | --     |                        |
| 7     | 105.05  | 5.14 (q, 5.5) | CH         | 1.28     | --     |                        |
| 8     | 30      | 1.24 (m)   | CH$_2$     | 5.33     | 104.4, 105.05 |                        |
| 9     | 104.4   | 5.33      | CH         | 1.24     | --     |                        |
| 10    | 64.6    | 3.59 (m) 3.89 (m) | CH$_2$     | 1.18     | 15.57, 104.4 |                        |
| 11, 13| 15.57   | 1.18 (t, 7 ) | CH$_3$     | 3.59, 3.89, 3.48 | 64.6, 66.8 |                        |
| 12    | 66.8    | 3.48 (q,7) | CH$_2$     | 1.15     | 15.4, 104.4 |                        |
| 14, 17| 18.5    | 1.28 (d, 5.9) | CH$_3$     | 4.95, 5.14 | 105.05, 15.4 |                        |
| 15, 16| 18.5    | 1.33 (d, 5.7) | CH$_3$     | 5.23, 5.38 | 103, 105.18 |                        |
| 1'    | 30.6    | -         | C quaternary | -        | -      |                        |
| 2'    | 30      | 1.33      | CH$_2$     | 0.83     | 23.9   |                        |
| 3'    | 14.38   | 0.83(m)   | CH         | 1.31, 1.33 | 23.9, 30 |                        |
| 4'    | 18.38   | 1.31 (m)  | CH         | 0.83, 0.91, 5.07 | 14.38, 23.9, 30, 31.5, 105.05 |                        |
| 5'    | 11.38   | 0.91 (m)  | CH         | 1.37, 1.42 | 24.8, 40 |                        |
| 6'    | 24.8    | 1.42 (m)  | CH$_2$     | 0.91     | 11.38, 18.38, 31.5, 40, 169 |                        |
| 7'    | 31.5    | 1.37 (m)  | CH$_2$     | 0.91, 1.68 | 18.38   |                        |
| 8'    | 40      | 1.68 (p, 6.1) | CH         | 1.37, 4.21 | 11.38, 24.8, 30.6, 31.5 |                        |
| 9'    | 23.9    | 1.33(d, 5.7) | CH$_2$     | 0.83     | 14.38, 30 |                        |
| 10'   | 69      | 4.21(m)   | CH$_2$     | 1.68     | 30.6, 31.5, 40, 169 |                        |
| 1'', 2'', 6'' | 133.4 | -         | C quaternary | -        | -      |                        |
| 3'', 5'' | 132.3 | 7.6 (m)   | =CH (aromatic) | 129.7   | 129.7, 169 |                        |
| 4''   | 129.7   | 7.7 (m)   | =CH (aromatic) | 132.3   | 132.3, 133.4 |                        |
| 7'', 8'', 9'' | 169.1 | -         | C=O        | -        | -      |                        |
| OH    |         |           | OH         | 11.5     |        |                        |
| OH    |         |           |            | 11.44    |        |                        |
Fig. S1. The HPLC chromatograms of the diethyl ether extract. The analysis was performed on ODS column with methanol as a mobile phase and detection at 240nm.

Fig. S2: The GC/MS chromatogram for the pure antifungal compound produced by *S. toxytrici*.

Fig.S3: The mass spectrum of the antifungal compound produced by *S. toxytrici*. 
Fig. S4: H\textsuperscript{1}-NMR spectrum of the antifungal compound produced by *S. toxycruci*
Fig. S5: $^{13}$C spectrum of the antifungal compound produced by *S. toxycrici*
Fig. S6: APT spectrum of the antifungal compound produced by *S. toxytrici*
Fig. S7: HSQC spectrum of the antifungal compound produced by *S. toxytrici*
Fig. S8: COSY spectrum of the antifungal compound produced by *S. toxycruci*
Fig. S9: HMBC spectrum of the antifungal compound produced by *S. toxytrici*
Fig. S10. The HMBC data interpretation of the antifungal compound produced by *S. toxytricini*. 