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Synthesis and antimycotic properties of hydroxy sulfides derived from *exo*- and *endo*-4-phenyl-3,5,8-trioxabicyclo[5.1.0]octanes

Roman S. Pavelyev*, Sergey G. Gnevashev, Rusalia M. Vafina, Oleg I. Gnezdilov, Alexey B. Dobrynin, Svetlana A. Lisovskaya, Liliya E. Nikitina and Evgenii N. Klimovitskii

X-ray diffraction analysis of crystals was performed on a Bruker Smart APEX II CCD (λMoKα) automatic diffractometer. The structure was solved by direct method using SIR program and refined by the full matrix least-squares using SHELXL-97 program. All non-hydrogen atoms were refined anisotropically. All hydrogen atoms were placed into the geometrically calculated positions and refined as riding atoms. All calculations were performed using WinGX program. All the figures and analysis of intermolecular interactions were performed using PLATON program.

^{1}H and ^{13}C NMR spectra were recorded on a Bruker AVANCE 400 spectrometer at operating frequency 400 and 100 MHz, respectively, and TMS as internal standard. The chemical shifts were determined relatively to deuterium resonance of $CDCl_3$.

Gas chromatography/mass spectrometry conditions. Instrument – DFS «Thermo Electron Corporation». Method of ionization – Electron ionization. Electron energy – 70 eV. Ion source temperature – 280 °C. Capillary column DB-5MS (30×0.25). Gas-carrier – helium. Gas-carrier rate – 1 ml min^{-1}. Injector temperature – 250 °C. Temperature gradient: 50 °C (1 min) – 6 grad min^{-1} – 120 °C – 20 grad m^{-1} in – 280 °C (15 min). Sample volume – 0,3 μl

The melting points were determined on a Kofler apparatus and uncorrected. Rotatory angles determined using polarimeter «Automatic digital polarimeter P3001/3002 RS» in CH_2Cl_2. The chromatographic stationary phase was silica gel.

4-Phenyl-3,5,8-trioxabicyclo[5.1.0]octanes **2a,b**. Oxone (104.0 g, 169 mmol) was added by portions at stirring to a solution of 2-phenyl-1,3-dioxacyclohept-5-ene **1 (**22.9 g, 130.2 mmol) in a mixture of 50 ml acetone, 50 ml H_2O and $NaHCO_3$ (52 g, 619 mmol) for 3 h at room temperature. Then reaction mixture was additionally stirred for 1 h. The product was extracted

with CH_2Cl_2 (2x50 ml). Organic phases were combined and dried with $MgSO_4$. A mixture of isomers **2a, 2b** was obtained as colorless crystals. Yield 22.14 g (89%). Isomers were separated by column chromatography [petroleum–ethyl acetate (7:1)] to give individual isomers **2a, 2b** in the ratio 1:2. *exo*-Isomer **2a**, mp 66–67 °C, *endo*-isomer **2b** 82–83 °C (*cf.* ref. 12).

Hydroxy sulfides **3a,b** *(general procedure).* A mixture of thiophenol (2.7 mmol), K_2CO_3 (0.15 mmol) and epoxide **2** (2.6 mmol) was heated before the appearance of first bubbles, after that heating was stopped. The short-time (<1 min) boiling up with a sharp self-heating occurred. The reaction mixture was cooled, and the product was purified by column chromatography [petroleum–ethyl acetate (4:1)].

Sulfones **4a-c, 6a-c** *(general procedure).* Oxone (2.0 mmol) was added by portions with stirring for 1.5 h to a solution of a sulfide (1.5 mmol) in 20 ml of aqueous acetone (1:1) and $NaHCO_3$ (7.3 mmol). The reaction mixture was stirred for additional 1 h, after that $CHCl_3$ was added. The aqueous layer was separated, saturated with NaCl, and extracted with $CHCl_3$. The organic phases were combined and dried with $MgSO_4$. The product was purified by column chromatography [petroleum–ethyl acetate (2:1)].

Acetates **5a-c** *(general procedure).* Acetic anhydride (7.5 mmol), Et_3N (7.5 mmol) and DMAP (0.05 mmol) were added sequentially to a stirred solution of hydroxy sulfide (5 mmol) in 20 ml CH_2Cl_2. After stirring for 1 h, a solvent was evaporated under reduced pressure, and the product was purified by column chromatography [petroleum–ethyl acetate (7:1)].

(rac)-2t-Phenyl-6t-phenylthio-1,3-dioxepan-5r-ol **3a**. Yield 73%, colorless crystals, mp 96–97 °C. ^{1}H NMR, δ: 2.91 d. (1H, OH, ^3J(OH H^5) = 6.5 Hz); 3.30 m (1H, H^6, ^3J(H^6 H^5) = 5.6 Hz, ^3J(H^6 $H^7{}_A$) = 5.8 Hz, ^3J(H^6 $H^7{}_B$) = 2.55 Hz); 3.64 m (1H, $H^4{}_A$, ^2J($H^4{}_A$ $H^4{}_B$) = -12.15 Hz, ^3J($H^4{}_A$ H^5) = 6.05 Hz, ^4J($H^4{}_A$ H^6) = -1.05 Hz); 3.71 m (1H, H^5, ^3J(H^5 $H^4{}_B$) = 1.8 Hz); 4.00 m (1H, $H^7{}_A$, ^2J($H^7{}_A$ $H^7{}_B$) = -12.6 Hz); 4.09 m (1H, $H^7{}_B$); 4.20 m (1H, $H^4{}_B$); 5.77 s (1H, H^2); 7.23-7.52 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 56.66 (C^6), 64.88 (C^7), 66.80 (C^4), 72.97 (C^5), 101.52 (C^2), 128.21, 128.70, 129.89, 130.13, 130.91, 133.05, 136.67, 141.06 (2 C_6H_5). MS (EI) m/z (%): 302 ($M^{+\cdot}$, 4).

(rac)-2t-Phenyl-6t-phenylsulfonyl-1,3-dioxepan-5r-ol **4a**. Yield 79%, colorless oily substance. ^{1}H NMR, δ: 3.36 m (1H, H^6, ^3J(H^6 H^5) = 6.4 Hz, ^3J(H^6 $H^7{}_A$) = 8.2 Hz, ^3J(H^6 $H^7{}_B$) = 3.4 Hz); 3.70 s (1H, OH); 3.83 m (1H, $H^4{}_A$, ^2J($H^4{}_A$ $H^4{}_B$) = -12.5 Hz, ^3J($H^4{}_A$ H^5) = 6.6 Hz); 3.91 m (1H, $H^4{}_B$, ^3J($H^4{}_B$ H^5) = 3.1 Hz); 3.92 m (1H, $H^7{}_A$, ^2J($H^7{}_A$ $H^7{}_B$) = -12.8 Hz); 4.08 m (1H, $H^7{}_B$); 4.29 m (1H, H^5); 5.57 m (1H, H^2); 7.22-7.93 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 60.27 (C^7), 66.13

(C^4), 67.52 (C^5), 69.49 (C^6), 101.24 (C^2), 125.92, 128.01, 128.40 128.49, 129.27, 134.17, 137.30, 137.46 ($2C_6H_5$). MS (EI) m/z (%): 334 ($M^{+\cdot}$, 4).

(rac)-5r-Acetoxy-2t-phenyl-6t-phenylthio-1,3-dioxepane **5a**. Yield 80%, yellow oily substance. ^{1}H NMR (d-acetone), δ: 1.91 s (3H, CH_3); 3.40 m (1H, H^6, $^3J(H^6\ H^5)$ = 5.4 Hz, $^3J(H^6\ H^7{}_A)$ = 5.75 Hz, $^3J(H^6\ H^7{}_B)$ = 2.45 Hz); 3.58 m (1H, $H^4{}_A$, $^2J(H^4{}_A\ H^4{}_B)$ = -12.66 Hz, $^3J(H^4{}_A\ H^5)$ = 5.7 Hz); 3.83 m (1H, $H^7{}_A$, $^2J(H^7{}_A\ H^7{}_B)$ = -12.37 Hz); 3.95 m (1H, $H^4{}_B$, $^3J(H^4{}_B\ H^5)$ = 2.28 Hz); 4.05 m (1H, $H^7{}_B$); 4.74 m (1H, H^5); 5.65 s (1H, H^2); 7.11-7.44 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 21.06 (CH_3), 52.2 (C^6), 61.7 (C^7), 63.55 (C^4), 73.39 (C^5), 99.84 (C^2), 126.41, 127.32, 128.19, 128.57, 129.04, 131.69, 133.65, 138.1 (2 C_6H_5), 170.05 (CO). MS (EI) m/z (%): 344 ($M^{+\cdot}$, 3).

(rac)-5r-Acetoxy-2t-phenyl-6t-phenylsulfonyl-1,3-dioxepane **6a**. Yield 70%, colorless crystals, mp 103−104°C. ^{1}H NMR, δ: 1.93 s (3H, CH_3); 3.46 m (1H, H^6, $^3J(H^6\ H^5)$ = 5.0 Hz, $^3J(H^6\ H^7{}_A)$ =3.15 Hz, $^3J(H^6\ H^7{}_B)$ = 5.3 Hz); 3.70 m (1H, $H^4{}_A$, $^2J(H^4{}_A\ H^4{}_B)$ = -12.75 Hz, $^3J(H^4{}_A\ H^5)$ = 5.8 Hz); 4.06 m (1H, $H^4{}_B$, $^3J(H^4{}_B\ H^5)$ = 2.7 Hz); 4.27 m (1H, $H^7{}_A$, $^2J(H^7{}_A\ H^7{}_B)$ = -13.1 Hz); 4.41 m (1H, $H^7{}_B$); 5.35 m (1H, H^5); 5.73 s (1H, H^2); 7.29-8.10 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 20.72 (CH_3), 58.99 (C^7), 62.86 (C^4), 67.21 (C^6), 68.91 (C^5), 100.77 (C^2), 126.42, 128.19, 128.83, 129.26, 130.15, 134.07, 137.19, 138.34 (2 C_6H_5), 169.5 (CO). MS (EI) m/z (%): 376 ($M^{+\cdot}$, 4).

(rac)-2c-Phenyl-6t-phenylthio-1,3-dioxepan-5r-ol **3b.** Yield 80%, colorless crystals, mp 82−83 °C. ^{1}H NMR, δ: 2.88 s (1H, OH); 3.15 m (1H, H^6, $^3J(H^6\ H^5)$ = 5.2 Hz, $^3J(H^6\ H^7{}_A)$ = 6.35 Hz, $^3J(H^6\ H^7{}_B)$ = 3.0 Hz); 3.68 m (1H, H^5, $^3J(H^5\ H^4{}_A)$ = 5.85 Hz, 1H, $^3J(H^5\ H^4{}_B)$ = 2.1 Hz); 3.71 m (1H, $H^7{}_A$, $^2J(H^7{}_A\ H^7{}_B)$ = -12.6 Hz); 3.79 m (1H, $H^4{}_A$, $^2J(H^4{}_A\ H^4{}_B)$ = -12.2 Hz); 4.03 m (1H, $H^7{}_B$); 4.04 m (1H, $H^4{}_B$); 5.67 s (1H, H^2); 7.08-7.47 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 46.71 (C^6), 63.98 (C^7), 71.54 (C^4), 80.00 (C^5), 102.22 (C^2), 126.37, 127.28, 128.32, 129.19, 129.23, 132.06, 135.08, 137.72 (2 C_6H_5). MS (EI) m/z (%): 302 ($M^{+\cdot}$, 7).

(rac)-2c-Phenyl-6t-phenylsulfonyl-1,3-dioxepan-5r-ol **4b.** Yield 89%, colorless oily substance. ^{1}H NMR, δ: 3.25 m (1H, H^6, $^3J(H^6\ H^5)$ = 6.6 Hz, $^3J(H^6\ H^7{}_A)$ = 3.3 Hz, $^3J(H^6\ H^7{}_B)$ = 7.45 Hz); 3.62 m (1H, $H^4{}_A$, $^2J(H^4{}_A\ H^4{}_B)$ = -12.15 Hz, $^3J(H^4{}_A\ H^5)$ = 7.95 Hz); 3.72 m (1H, $H^7{}_A$, $^2J(H^7{}_A\ H^7{}_B)$ = -13.10 Hz); 3.79 s (1H, OH); 3.9 m (1H, $H^7{}_B$); 4.04 m (1H, $H^4{}_B$, $^3J(H^4{}_B\ H^5)$ = 3.3 Hz); 4.23 m (1H, H^5); 5.54 m (1H, H^2); 7.14-7.83 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 57.53 (C^7), 66.26 (C^4), 67.23 (C^5), 69.46 (C^6), 100.28 (C^2), 126.11, 128.04, 128.46 128.54, 129.24, 134.13, 137.33, 137.39 ($2C_6H_5$). MS (EI) m/z (%):334 ($M^{+\cdot}$, 3).

(rac)-5r-Acetoxy-2c-phenyl-6t-phenylthio-1,3-dioxepane **5b.** Yield 95%, yellow oily substance. ^{1}H NMR, δ: 2.00 s (3H, CH_3); 3.30 m (1H, H^6, $^3J(H^6\ H^5)$ = 5.8 Hz, $^3J(H^6\ H^7{}_A)$ = 6.7 Hz, $^3J(H^6\ H^7{}_B)$ = 2.6 Hz); 3. 74 m (1H, $H^7{}_A$, $^2J(H^7{}_A\ H^7{}_B)$ = -12.45 Hz); 3.91 m (1H, $H^4{}_A$, $^2J(H^4{}_A$

H^4_B) = -12.7 Hz, $^3J(H^4_A\ H^5)$ = 5.65 Hz); 4.02 (1H, H^4_B, $^3J(H^4_B\ H^5)$ = 2.40 Hz); 4.17 m (1H, H^7_B); 4.94 m (1H, H^5); 5.69 s (1H, H^2); 7.17-7.48 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 21.03 (CH_3), 51.90 (C^6), 63.59 (C^7), 63.89 (C^4), 73.66 (C^5), 100.68 (C^2), 126.22, 127.50, 128.17, 128.51, 129.09, 132.03, 133.37, 138.53 (2 C_6H_5), 170.08 (CO). MS (EI) m/z (%): 344 ($M^{+\cdot}$, 2).

(rac)-5r-Acetoxy-2c-phenyl-6t-phenylsulfonyl-1,3-dioxepane **6b.** Yield 97%, colorless crystals, mp 120−121 °C. ^{1}H NMR, δ: 1.83 s (3H, CH_3); 3.56 m (1H, H^6, $^3J(H^6\ H^5)$ = 5.67 Hz, $^3J(H^6\ H^7_A)$ =7.2 Hz, $^3J(H^6\ H^7_B)$ = 2.9 Hz); 4.04 m (1H, H^4_A, $^2J(H^4_A\ H^4_B)$ = -13.3 Hz, $^3J(H^4_A\ H^5)$ = 4.7 Hz); 4.06 m (1H, H^4_B, $^3J(H^4_B\ H^5)$ = 2.8 Hz); 4.16 m (1H, H^7_A, $^2J(H^7_A\ H^7_B)$ = -12.95 Hz); 4.49 m (1H, H^7_B); 5.41 m (1H, H^5); 5.65 s (1H, H^2); 7.30-8.15 m (10H, $2C_6H_5$). ^{13}C NMR, δ: 20.63 (CH_3), 60.09 (C^7), 66.49 (C^4), 67.60 (C^6), 69.59 (C^5), 102.58 (C^2), 126.18, 128.25, 128.83, 129.36, 129.82, 130.20, 130.95, 134.64 (2 C_6H_5), 170.68 (CO). MS (EI) m/z (%): 376 ($M^{+\cdot}$, 3).

4-Hydroxymethyl-2-phenyl-5-phenythio-1,3-dioxane **3c**. A mixture of isomeric dioxepanes **3a** and **3b** (1g, 3.31 mmol) was dissolved in 15 ml $CHCl_3$, then a catalytic amount of *p*-toluenesulfonic acid was added. A solution was colored to red color for 1h. After the solvent was evaporated under reduced pressure, the product was purified by column chromatography [petroleum−ethyl acetate (4:1)] to give 0.85g (85%), colorless crystals, mp 96−97°C. ^{1}H NMR, δ: 1.98 m (1H, OH, ^3J(OH C$\underline{H}_A H_B$OH) = 8.35 Hz, ^3J(OH C$H_A\underline{H}_B$OH) = 3.4 Hz); 3.24 m (1H, H^5, $^3J(H^5\ H^4)$ = 2.2 Hz, $^3J(H^5\ H^6_A)$ = 2.1 Hz, $^3J(H^5\ H^6_B)$ = 1.45 Hz); 3.79 m (1H, C$\underline{H}_A H_B$OH, ^2J(C$\underline{H}_A H_B$OH C$H_A\underline{H}_B$OH) = -11.7 Hz, ^3J(C$\underline{H}_A H_B$OH H^4) = 4.9 Hz); 4.04 m (1H, C$H_A\underline{H}_B$OH, ^3J(C$H_A\underline{H}_B$OH H^4) = 7.5 Hz); 4.24 m (1H, H^6_A, $^2J(H^6_A\ H^6_B)$ = -11.8 Hz); 4.33 m (1H, H^4); 4.36 m (1H, H^6_B); 5.60 s (1H, H^2); 7.22-7.59 m (10 H, C_6H_5). ^{13}C NMR, δ: 46.73 (C^5), 64.00 ($\underline{C}H_2OH$), 71.56 (C^6), 79.98 (C^4), 102.23 (C^2), 126.37, 127.31, 128.34, 129.20, 129.24, 132.08, 135.08, 137.72 ($2C_6H_5$). MS (EI) m/z (%): 302 ($M^{+\cdot}$, 19).

4-Hydroxymethyl-2-phenyl-5-phenylsulfonyl-1,3-dioxane **4c.** Yield 79%, colorless oily substance. ^{1}H NMR, δ: 1.96 s (1H, OH); 3.34 m (1H, H^5, $^3J(H^5\ H^4)$ = 3.0 Hz, $^3J(H^5\ H^6_A)$ = 3.3 Hz, $^3J(H^5\ H^6_B)$ = 0.7 Hz); 4.09 m (1H, C$\underline{H}_A H_B$OH, ^2J(C$\underline{H}_A H_B$OH C$H_A\underline{H}_B$OH) = -12.3 Hz, ^3J(C$\underline{H}_A H_B$OH H^4) = 7.4 Hz); 4.21 m (1H, H^6_A, $^2J(H^6_A\ H^6_B)$ = -13.3 Hz); 4.21 m (1H, C$H_A\underline{H}_B$OH, ^3J(C$H_A\underline{H}_B$OH H^4) = 7.43 Hz); 4.42 m (1H, H^4); 4.80 m (1H, H^6_B); 5.42 s (1H, H^2); 6.86-8.05 m (10 H, C_6H_5). ^{13}C NMR, δ: 61.13 (C^5), 62.31 ($\underline{C}H_2OH$), 67.01 (C^6), 77.83 (C^4), 102.59 (C^2), 126.13, 127.94, 129.02, 129.28, 129.77, 133.78, 136.55, 139.53 ($2C_6H_5$). MS (EI) m/z (%): 334 ($M^{+\cdot}$, 7).

4r-Acetoxymethyl-2c-phenyl-5c-phenythio-1,3-dioxane **5c.** Yield 88%, colorless crystals, mp 104−105 °C. ^{1}H NMR, δ: 1.99 s (3H, CH_3); 3.22 m (1H, H^5, $^3J(H^5\ H^6_A)$ = 2.05 Hz, $^3J(H^5$

H^6_B) = 1.5 Hz); 4.28 m (1H, H^6_A, $^2J(H^6_A\ H^6_B)$ = - 11.8 Hz); 4.35-4.46 m (4H, H^6_B, H^4, $C\underline{H}_A\underline{H}_BOH$); 5.59 s (1H, H^2); 7.22 – 7.58 m (10 H, C_6H_5). ^{13}C NMR, δ: 20.73 (CH_3), 47.74 (C^5), 65.26 ($\underline{C}H_2OH$), 71.97 (C^6), 77.40 (C^4), 102.12 (C^2), 126.34, 127.37, 128.32, 129.15, 129.21, 132.35, 135.32, 137.58 ($2C_6H_5$), 170.64 (CO). MS (EI) m/z (%): 344 ($M^{+\cdot}$, 18).

4-Acetoxymethyl-2-phenyl-5-phenylsulfonyl-1,3-dioxane **6c.** Yield 93%, colorless crystals, mp 133−134 °C. ^{1}H NMR, δ: 1.96 s (3H, CH_3); 3.18 m (1H, H^5, $^3J(H^5\ H^4)$ = 2.75 Hz, $^3J(H^5\ H^6_A)$ = 3.3 Hz, $^3J(H^5\ H^6_B)$ = 0.9 Hz); 4.13 m (1H, H^6_A, $^2J(H^6_A\ H^6_B)$ = -13.15 Hz); 4.37 m (1H, H^4, $^3J(H^4\ C\underline{H}_AH_BOH)$ = 8.25 Hz, $^3J(H^4\ CH_A\underline{H}_BOH)$ = 3.95 Hz); 4.52 m (1H, $C\underline{H}_AH_BOH$, $^2J(C\underline{H}_AH_BOH\ CH_A\underline{H}_BOH)$ = -12.3 Hz); 4.69 m (1H, $CH_A\underline{H}_BOH$); 4.78 m (1H, H^6_B); 5.32 s (1H, H^2); 6.74-7.92 m (10 H, C_6H_5). ^{13}C NMR, δ: 20.81 (CH_3), 61.89 (C^5), 64.67 ($\underline{C}H_2OH$), 67.04 (C^6), 76.03 (C^4), 102.59 (C^2), 126.07, 127.90, 128.91, 129.18, 129.86, 133.61, 136.41, 140.02 ($2C_6H_5$), 170.61 (CO). MS (EI) m/z (%): 376 ($M^{+\cdot}$, 5).

The separation of racemic **3b** *to enantiomers by fermentative acylation with the use of lipase PS.* A mixture of 1.53 ml vinyl acetate and 1.25 g lipase PS immobilized on a diatomite, was added to the solution of racemic **3b** in 30 ml of THF. The mixture was stirred at 40 °C for 90 days and filtered. The filtrate was evaporated under reduced pressure and the residue was separated by column chromatography [petroleum−ethyl acetate (7:1)].

(+)-(2R,5S,6S)- 5-Hydroxy-2-phenyl-6-phenylthio-1,3-dioxepane **3b**. Yield 42%, mp 53−54 °C, $[\alpha]^{24}_D$ = + 0.7 (*c*, 5; CH_2Cl_2). The ^{1}H NMR spectrum is identical to that of the racemic sample.

(−)-(2S,5R,6R)-5-Acetoxy-2-phenyl-6-phenylthio-1,3-dioxepane **5b**. Yield 40%, $[\alpha]^{24}_D$ = −24.2 (*c*, 5; CH_2Cl_2). The ^{1}H NMR spectrum is identical to that of the racemic sample.

(+)-(2R,5S,6S)-5-Acetoxy-2-phenyl-6-phenylthio-1,3-dioxepane **5b**. Yield 82%, $[\alpha]^{24}_D$ = 24.2 (*c*, 5; CH_2Cl_2). The ^{1}H NMR spectrum is identical to that of the racemic sample.

(−)-(2S,5R,6R)-5-Hydroxy-2-phenyl-6-phenylthio-1,3-dioxepane **3b**. Potassium carbonate (1.28 g, 9.3 mmol) was added to a solution of (−)-(2*S*,5*R*,6*R*)-**5b** in 20 ml methanol. The mixture was stirred for 1 h, filtered and concentrated. The residue was purified by column chromatography [petroleum−ethyl acetate (1:1)]. Yield 0.79 g, (84%), mp 53−54 °C, $[\alpha]^{24}_D$ = −0.7 (*c*, 5; CH_2Cl_2). The ^{1}H NMR spectrum is identical to that of the racemic sample.

The *fungal activity* has been determined for 3 strains: *Candida albicans* (clinical strain), *Aspergillus fumigatus* (typical strain), *Epidermophyton floccosum* (clinical strain). Fungal strains were obtained from the collection of typical and clinical cultures from the mycological laboratory of Kazan Research Institute of Epidemiology and Microbiology.

The fungal activity was evaluated *in vitro* by Minimum Inhibitory Concentration (MIC) test according to NCCLS. Analyzed/tested substances were dissolved in Saburo medium in concentrations two times exceeded required and 1 ml was applied to each tube with following addition of 1 ml fungal spore suspension 10^6 of 1 ml. The required concentrations were: 10; 5; 2.5; 1.2; 0.6; 0.3; 0.15; 0.07; 0.03 mg ml^{-1}. Fungal spore solution or vegetative cells were obtained from viable 48-hours old yeast-like fungal culture and 6 days old mycelial fungi. Tubes were incubated at 28−30 ^{o}C for 9 days. Culture growth was measured with photoelectric colorimeter at 530 nm and compared to the corresponding control (blank medium).