Microalgae for Wastewater Treatment and Biofuel Production: Effect of Pharmaceuticals on Cellular Lipid Content

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Using microalgae to treat municipal wastewater has raised increasing interest because of the potential benefits for contaminant removal and biofuel production. Beside conventional contaminants, municipal wastewater has been shown to contain detectable concentrations of pharmaceuticals originating from human excretion and domestic disposal. Pharmaceuticals are biologically active compounds that may affect living organisms at very low doses. In this study, a 96-well microplate-based cultivation system was used to determine changes in biomass and lipid production in the model freshwater alga, *Chlorella vulgaris*, exposed to a suite of nine pharmaceuticals: acetaminophen, atenolol, carbamazepine, erythromycin, estrone, gemfibrozil, ibuprofen, sulfamethoxazole, and tetracycline. *C. vulgaris* was cultivated for 14 days in Bristol medium dosed with the pharmaceuticals at concentrations of 0.0, 0.40, 1.56, 6.25, 25, and 100 µM. The algal biomass and cellular neutral lipids were measured by the optical density (680 nm) and Nile red fluorescence (530/580 nm), respectively. Exposure to pharmaceuticals did not result in observable effects on algal growth at concentrations below 25 µM, except for sulfamethoxazole and tetracycline, which showed inhibitory effects at 0.4 and 6.25 µM, respectively. Interestingly, a significant increase in neutral lipid was detected in the presence of acetaminophen, atenolol, gemfibrozil, estrone, and carbamazepine (at all concentrations tested) as compared with non-exposed controls. On the other hand, exposure to erythromycin, tetracycline, and ibuprofen increased cellular lipids only at low concentrations. Unlike other pharmaceuticals tested, sulfamethoxazole caused a decrease in neutral lipid at all concentrations. These results show that exposure to most common pharmaceuticals at low levels, as likely to occur in municipal wastewater, may enhance or inhibit lipid accumulation in microalgae.

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