Biodegradation of exogenous DNA by bio-products used in domestic sewage farms

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The amount of free microbial DNA derived from human environment in biological sewage plants or domestic sewage farms is significant. If not degraded, this DNA may participate in a natural genetic transformation of bacteria that encompasses an active uptake of free (exogenous) DNA and a heritable incorporation of the genetic information into bacterial genome. This process may lead to the acquisition of new features, such as resistance to antibiotics. Therefore, it is of a vital interest to know whether the commercial biological products (mixtures of microorganisms) used in domestic sewage farms for waste utilisation are able to degrade DNA.

The 4 bio-products (Bio7 CHOC-granulate, Bio7 CHOC-capsules, Microsafe-A and Septifine) were examined in order to check their ability to degrade an exogenous DNA. The suitable amount of bio-product to obtain the concentration recommended by the manufacturer was resuspended in 50 ml of 0.08 M phosphate buffer (pH 7.0 ± 0.2) supplemented with 0.95% glucose. The reaction was started by addition of 50 mg of DNA or appropriate nucleotide to the 50 ml of bio-product suspension. The mixture was incubated at 30°C in a rotary shaker at 100 rpm and samples were taken in indicated time intervals for HPLC analysis. The filtrated sample (20 µl) was injected into Hypersil 5 C18 column (25 cm, 4.6 mm x 5 µm) and analysis was performed on HPLC apparatus with spectrophotometric detector UV/Vis (λ = 254 nm). An aqueous buffer (0.02 M NaH2PO4, pH 4) with acetonitrile 3.8% was used as a mobile phase (flow rate 1 ml/min).

Three bio-products (Bio7 CHOC-capsules, Bio7 CHOC-capsules and Septifine) were able to degrade DNA. After 240 hrs of hydrolysis, nucleic bases or their derivatives were found in the reaction mixture. Interestingly, no nucleic bases or their derivatives neither pure peak absorption at 254 nm were found after 480 hrs of reaction. We conclude that above mentioned bio-products are capable to degrade DNA to CO2 and NH3 or N2. The maximum concentration of DNA, which did not influence the growth of microorganisms was 3 mg ml⁻¹.

The ability to degrade DNA to CO2 and NH3 or N2 is not a common feature among the microorganisms, thus the ability of bio-products used in domestic sewage plants to carry out the complete degradation of DNA is beneficial as the amount of DNA from biological lysates is high in this type of waste. This activity was not mentioned in advertisement materials.

Keywords: DNA biodegradation; bio-products; biological sewage farms

Biodeterioration of San Roque Church, Campeche, Mexico

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The city of Campeche with examples of 16th-19th century architecture was considered a World Cultural Heritage site by the United Nations UNESCO. More than a thousand buildings of historical value have survived as witnesses of the historical stages in Mexico since the XVI century. San Roque church was built at the end of the 17th century with limestone and mortar and nowadays shows important biodeterioration processes. An exhaustive sampling was carried out in 2005 to investigate the biodeterioration processes and the origin of the dark green to brown stains covering the upper part of the church facade. Then, a microbiological, petrographic, petrophysical and biochemical characterisation of samples were carried out.

In all mortars a matrix of calcium carbonate binder supports poorly sorted aggregate, and show a variable binder to aggregate ratio ranging from 1:4 to 1:1. The binder is texturally similar to mortar carbonate rocks. It is composed almost totally of 1-30 µm thick calcite crystals, although tiny angular aragonite crystals have been locally observed. The aggregate in the analysed mortars is dominated by mollous shell fragments and biosicrite (foraminiferal mudstones-wackestones) grains. In some samples a network of calcite-cylindrical pores, rather perpendicularly oriented to the surface can be observed. These pores are related to microbial activity. The network expands up to 3-6 mm into the mortar from the surface.

Bacteria, cyanobacteria and eukaryes present in the wall surfaces were investigated. The data showed that actinobacteria and cyanobacteria were predominant in the biofilm.

Keywords: Biodeterioration, Bacterial activity, Biofilm