Terminating Cancer: Engineering the Taxol Biosynthesis Pathway in E. coli

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Though taxol (paclitaxel) is an anticancer drug used in many chemotherapy treatments, it is only found in its pure form in the bark of the rare Pacific yew tree. To obtain 1 gram of Taxol, the bark from three adult yew trees must be stripped, which also kills the trees. Focusing on developing a more economical and environmentally friendly method of synthesizing taxol precursors could potentially bypass these environmentally unfriendly methods. Escherichia coli were utilized to attempt to replicate the natural biochemical pathways that exist in yew trees via genetic engineering since utilizing organic chemistry has proven difficult and costly. The goal of this experiment was to synthesize geranylgeranyl diphosphate (GGPP) by extracting an mRNA copy of the human gene for geranylgeranyl pyrophosphate synthase (GGPS1), amplifying a cDNA version of the gene using a polymerase chain reaction (PCR) and a reverse transcriptase, inserting the gene into an expression plasmid using sticky-end ligation, and then inserting the plasmid into E. coli using heat-shock. The nucleotide sequence that was extracted from human subjects was sequenced and found to be homologous to GGPS1. The plasmid from bacteria was also confirmed to contain the right size fragment using a PCR followed by gel electrophoresis. Future experiments should continue the process of genetic engineering to include enzymes that would convert GGPP to the next taxol precursors. Ideally, the use of modified E. coli strains to synthesize taxol would allow for cheap, virtually unlimited amounts, of this life saving, cancer terminating drug.

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