CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1617

Project Title

The Effect of 28 kHz Ultrasound Exposure on the Transformation Efficiency of pGLO Plasmids into E. coli

Abstract

Objectives/Goals

Low frequency ultrasound (US), has been rarely used for transformation of non-competent cells which begs the question: how does 28kHz ultrasound affect plasmids and their transformation efficiency into E. coli?

Methods/Materials

I created LB plates with ampicillin, and arabinose (LB:AMP:ARA), ensuring that fabrication temperature was below AMP and ARA denaturation, so that they would have desired thickness, translucence, and even distribution of AMP and ARA (indicators of transformation). I performed the experiment with 2 different procedures: I initially mixed E. coli colonies from a streak plate with CaCl2, exposed to US for various times while adding pGLO in last 5 sec, mixed it with LB broth, and spread onto an LB:AMP:ARA plate; I modified my protocol by mixing more E. coli colonies, CaCl2, and pGLO, exposing it to US, mixing it with LB broth thoroughly, and spreading it onto an LB:AMP:ARA plate. After E. coli grew into colonies, images of the petri dishes were collected and a MatLab script analyzed images, counted colonies, and calculated transformation efficiency.

Results

For plates with pGLO added in last 5 sec of US exposure (no US exposure for plasmids, but full exposure for E. coli), there were few colonies (little to no transformation efficiency) per plate and no correlation between exposure time and transformation efficiency; all colonies that grew were fully transformed. For plates with pGLO exposed to US (full US exposure to plasmids and E. coli), there were 500% more colonies than the number normally grown when thermal shock is used for transformation of non-competent cells.

Conclusions/Discussion

After using a modified protocol, it was found that as the exposure time increased, the transformation efficiency increased exponentially, but only for colonies expressing the phenotype of ampicillin-resistance and not glowing under UV light. However, the colonies expressing both phenotypes had no correlation between exposure time and transformation efficiency. Because some of the colonies did not express all expected phenotypes, it suggests that some bacteria were only partially transformed, while colonies that expressed all expected phenotypes suggests some bacteria were completely transformed.

Summary Statement

I developed a protocol that created 2 types of E. coli from a single source using US which controlled the transformation of E. coli with exposure time and increased transformation efficiency of plasmids by 500% (compared to thermal shock).

Help Received

Using lab space and equipment at Beryl Technologies