Kinship Effects in Phenotypic Adaptation to Antibiotics in *E. Coli*

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Epigenetic effects contribute to bacterial resistance to antibiotics. To study these effects, we grew colonies of Escherichia coli in media containing cefsulodin, and made genealogical trees for each colony. We analyzed the kinship correlation of cell survival, and found that the survival rate of a cell's relatives only impacts that cell's chance of survival when dealing with the very closest relatives – siblings. We also found that cells which inherit a pole that is several generations old have a survival advantage over cells comprised of newer material.

***Keywords* — Antibiotic resistance, Cefsulodin, Epigenetics, Sister cells, Cell age**

EXTENDED ABSTRACT

ANTIBIOTIC susceptibility is a complex trait that varies from cell to cell, even when the cells are genetically identical. Our previous research indicates that antibiotic killing is in large part stochastic [1]. Characterizing the manner in which some cells in a growing bacterial colony show superior resistance than others, so that the colony as a whole will sometimes survive treatments that are lethal to many or most cells, is an important research area in the development of effective treatments for bacterial infections.

We subjected a susceptible population of *Escherichia coli* to an antibiotic (cefsulodin) at the concentration immediately below the MIC. We used an optical microscope to image cells as they grew from single cells to dozens or hundreds of cells. We analyzed the growth and death of individual cells and turned the dataset into a genealogical tree, precisely locating each bacterium among its relatives. We then calculated pairwise correlation in the survival rates of related cells, starting with siblings, and moving on to more distant relatives such as aunt/niece, first cousins, and so forth. We found a statistically significant correlation for the survival of siblings, but none for more distant relationships.

We then considered the effects of pole age on cell survival rates. Whenever rod-shaped bacteria divide, they pass down one of their two poles to each daughter cell; each daughter is therefore born with one old pole and one new pole. The new pole is always one generation old, but the old pole can be any number of generations old. Thus, some cells are partly made of biological material that is many generations older than the norm. When we compared the survival rates of these cells, we found that cells with old poles were significantly more likely to survive and reproduce than cells with newer poles. In light of previous studies showing a fitness disadvantage for for old poles under ribosome-targeting drug treatment [2], our data indicates that the epigenetic effects can vary under antibiotics with different mechanisms of action.

CONCLUSION

In conclusion, our research indicates that any epigenetic factors which strengthen or weaken *E. coli* with respect to cefsulodin treatment are unstable, being passed down for at most one generation. However, at the same time, the age of cell poles appears to play a significant role in determining the chance of survival over several generations.

REFERENCES

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