



University of Dayton  
Honors Program

# Combating Antibiotic Resistance Using Plant Derived Compounds

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Improper drug,  
dosage, or duration

Selective pressure for genes that  
support antibiotic resistance

1 out of 100 reported cases are fatal with  
over 200,000 cases reported annually.<sup>1</sup>

## ABSTRACT

One mechanism that bacteria use to become multi-drug resistant is the overexpression of membrane-embedded efflux pumps, such as the AcrAB-TolC pump found in *Escherichia coli* (*E. coli*) pictured below. This pump allows the bacterium to transport a variety of compounds out of the cell, including antibiotics that we use to combat bacterial infections. I determined that yerba maté extract causes accumulation of a fluorescent dye in live bacterial cells and has an antimicrobial effect of cells when incubated in a growth curve assay. This research could open a new avenue in the treatment of multi-drug resistant bacterial infections.<sup>2,3</sup>

## PROCEDURE

Soxhlet extraction of  
dried and ground  
produce samples

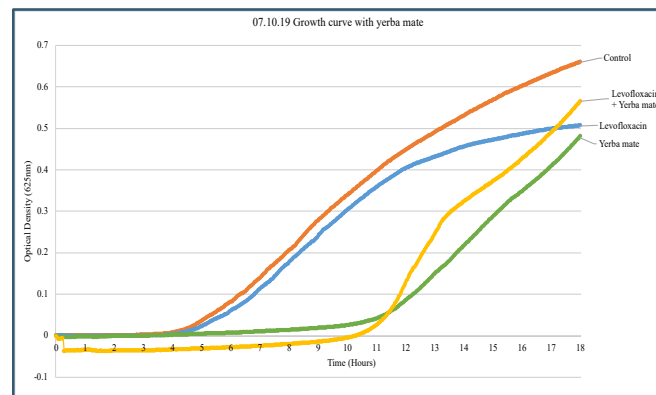
- Yerba maté, eggplant, carob powder, Puerh Tuo Cha tea, banana, Asian pear, blueberries, plum, apple, grapefruit, grapes, hazelnuts, pecans, decaf green tea

Ethidium bromide  
assay with *E. coli* cells

- Determines if the extract can cause accumulation of a fluorescent dye

Growth curve assay  
with antibiotics and  
*E. coli* cells

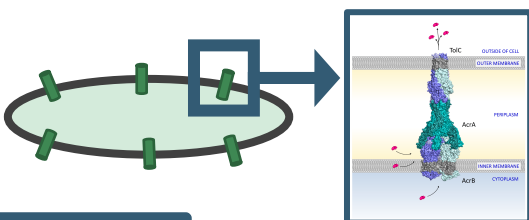
- Determines if extract can enhance the effectiveness of the clinically-relevant antibiotic



The cells treated with antibiotic, Levofloxacin, and yerba maté extract had a six-hour delay in growth which is indicated by a lower optical density value. The cells treated with yerba maté extract only had an even greater delay in growth which means the growth inhibition on the graph of the antibiotic and extract combined is likely due to the extract alone.

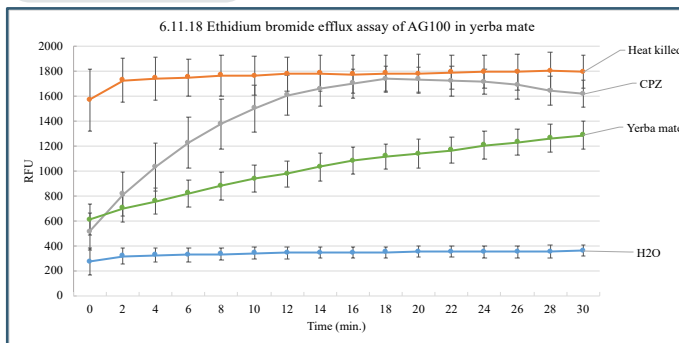
## CONCLUSIONS

The presence of yerba maté extract has an antimicrobial effect on the cells. Although the extract may not necessarily increase the cell susceptibility to antibiotics, the results of this research still have clinical relevance. The antimicrobial effect should be tested on other bacteria cells as well as fungi and mammalian cells in further research.



## HYPOTHESIS

Plants have been evolving longer than humans and must overcome bacteria on their own through natural compounds. I hypothesize that there is a low cost, minimally toxic plant-derived compound than can inhibit pump function and cause bacteria to be susceptible to antibiotics.



Cells treated with yerba maté extract and dye doubled in fluorescence over 30 minutes. The fluorescence was not as high as the two controls that are known to inhibit the pumps, heat-killed cells and CPZ treated cells. We still found this data significant enough to pursue yerba maté as a hit.

References: <sup>1</sup>World Health Organization. (2014). Antimicrobial Resistance. *Food Microbiology*, 19-44. doi: 10.1128/9781555818463. <sup>2</sup>Du, Dijun, et al. "Multidrug efflux pumps: structure, function, and regulation." *Nature Reviews Microbiology*, vol. 16, July 2018, pp. 523-539. doi: 10.1038/s41579-018-0048-6. <sup>3</sup>Pagés, Jean Marie, and Leonard Amaral. "Mechanisms of Drug Efflux and Strategies to Combat Them: Challenging the Efflux Pump of Gram-negative bacteria." *Biochimica et Biophysica Acta – Proteins and Proteomics*, vol. 1794, no. 5, Elsevier B.V., 2009, pp. 826-33. doi: 10.1016/j.bbapap.2008.12.011