Cantaurus, Vol. 29, 32-34, May 2021 © McPherson College Department of Natural Science

Does *Lactobacillus acidophilus* inhibit the growth of *Pseudomonas aeruginosa?*

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ABSTRACT

Antibiotic resistance is one of the heaviest economic burdens and global health threats of the 21st century. Many of the drugs that were breakthroughs in the past years are losing their impact due to the fast advancement of antibiotic resistance. Several options are being studied and are suggested as alternatives if we enter a post-antibiotic era. Probiotics are among the promising options. This study focuses on the antagonistic effects of one common probiotic species (*L. acidophilus)* against *P. aeruginosa.* The cross striking method was used, and inhibition zones were measured. Results showed effective inhibition after 24 hours, but the inhibition zones depressed, showing the adaptability of the pathogenic *P. aeruginosa.*

Keywords: *antibiotic resistance, probiotics, fermentation, quorum sensing, bacteriocin*

INTRODUCTION

Antibiotic resistance is defined as the ability of a microbe to resist the effects of a medication that once could successfully treat the infection associated with that microbe. It is one of the heaviest economic burdens and global health threats of the 21st century. This phenomenon emerged from the misuse of antibiotics in humans and other animals (Gandra, 2014). The consequences of antibiotic resistance include increased morbidity and mortality associated with bacterial infections and increased risks of infectious complications in procedures such as organ transplantations, chemotherapy, C-sections, etc. According to the World Health Organization, the increased and inappropriate use of antibiotics has led to the development of resistant bacteria. As a result, the drug discoveries that were breakthroughs of science in the last century might see their impact drop due to fast advancement of antibiotic resistance in bacteria. If this trend continues through the coming years, people may have infections for which antibiotic therapy may no longer be effective. Thus, we might head into a post-antibiotic era.

Different types of solutions have been suggested as a remedy to this undesirable situation. (Nongyao, 2017; Farzana, 2017; Tängdén, 2014; Sulakvelidze, 2001). The use of probiotics, sometimes combined with prebiotics or synbiotics, is emerging as one of the promising alternatives. Prebiotics are food compounds that are beneficial to the growth of microorganisms, such as probiotics, that play a beneficial role in bigger organisms such as humans. Probiotics have been associated with a decreased rate of postoperative infections, a better control of stomach ulcer (Kasatpibal, 2017), and a faster rate of healing of burn wounds in rats (Barzegari, 2019). The concept of probiotic use is constantly evolving. Research has documented that probiotics have positive influences that are not limited to the intestinal functions, but also extends to the skin level. Reports have been made that they can contribute to the regulation of the cutaneous microflora, lipid barrier and skin immune system (Caramia, 2008; Simmering, 2009).

An interesting property of probiotics is the fermentative metabolism that involves the production of acid molecules (e.g.,, lactic acid), thus acidifying the surrounding environment (Krutmann, 2009). Lactobacilli live as commensals in the human oral, gastrointestinal, and genito-urinal tracts. They are gram positive, microaerophilic, or facultative anaerobic rods that ferment to yield lactic acid (Salminen, 2004). Lactobacilli are normal commensal flora of the gut and as beneficial microbes are used in the therapy of gastrointestinal diseases and enhancement of intestinal health (Saez-Lara, 2014). *L. acidophilus* strain is a well-characterized probiotic bacterium, which has been reported to improve the production performance of animals as well as enhance their immune responses (Qiao, 2015). *Pseudomonas aeruginosa* is an opportunistic pathogen with resistance to many different types of antibiotics such as penicillin, carbapenems, aminoglycosides, and ciprofloxacin (Georgescu, 2015).

P. aeruginosa is among the major nosocomial pathogens and can demonstrate particularly all known enzymatic and mutational mechanism of bacterial resistance (Farzana,2014). Treatment of infections caused by these resistant bacterial pathogens relies on two therapeutic modalities: development of new antimicrobials and combination of available antibiotics (Farzana, 2014). The aim of this study is to determine the efficacy of *Lactobacillus acidophilus* as an antagonistic species against the multi-drug resistant *Pseudomonas aeruginosa*.

MATERIALS AND METHODS

Experimental design

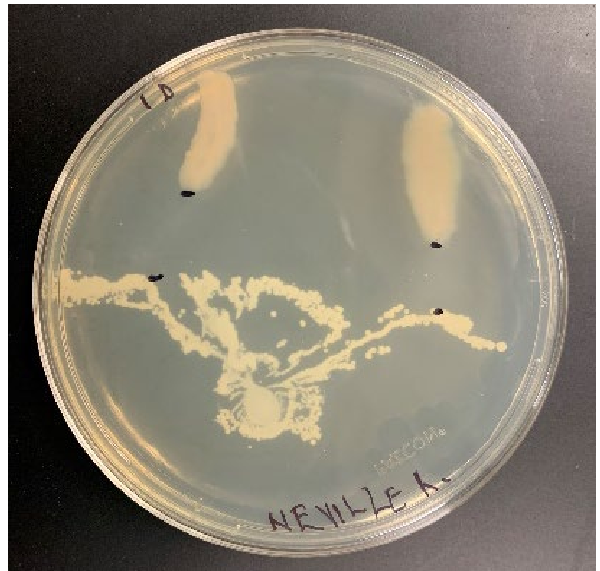
The aim of this study is to find out *if L. acidophilus* can have a negative effect on the growth of *P.aeruginosa.* Pure cultures of *L.acidophilus* and *P. aeruginosa* were obtained from MicroKwik Culture. The samples were incubated in Nutrient broth and MRS broth (Al-Malkey,2017; Neal-McKinney,2012) for *P.aeruginosa* and *L.acidophilus*, respectively.

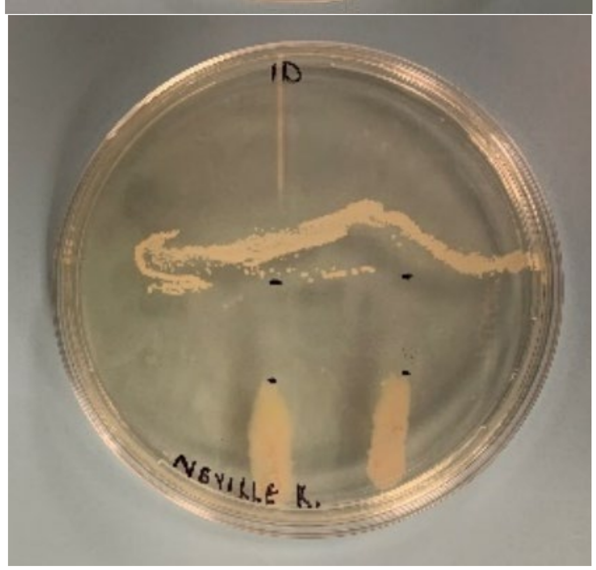
Five culture plates were inoculated with *L.acidophilus* on day one and on day two, they were inoculated at 90 degrees angle of the L. acidophilus streak with the *P.aeruginosa* culture. Five other culture plates were inoculated following the same sequence, but this time there was a 48h interval.

RESULTS

After our first trial, we observed an inhibition zone of 1.5 cm in diameter on average for the samples that were inoculated with *L. acidophilus* first and cross streaked with *P. aeruginosa* after 24hours.

	Diameter of Inhibition zone(cm)
	1.4
	1.7
	1.3
	1.8
	1.7
	1.5
	1.1
Average=	1.5





DISCUSSION

P. aeruginosa is one of the bacteria that cause huge burdens for public health today. This species has an ability to adapt its genome and physiology during chronic infections (Al-Malkey,2017). Some of the features making it a very successful opportunistic pathogen includes virulence factors, biofilm formation, motility, and quorum sensing (Al-Malkey,2017; Arques,2015). An inhibition zone of 1.5 cm was observed on average on day 1. It was observed that the inhibition zones tended to decrease as time passed. This observation can be attributed to the adaptability of *P.aeruginosa*. The results shows that L. acidophilus can inhibit the growth of a culture of *P.aeruginosa* after 24 hours.

Several factors may play a major role. These factors include the competitive exclusion between the bacteria, the presence of other secondary metabolites by *L. acidophilus,* such as lactic acid, biosurfactant, and other fermentation products such as bacteriocins (Al-Malkey, 2017). Antimicrobial effects of bacteriocin production can contribute to probiotics in three different mechanisms (Dobson, 2012). Firstly, they can act as colonizing peptides. In environments where there is close cell-cell contact between members of the same or different species, both cooperative and antagonistic microbial interactions can be observed. The production of antimicrobials provides a mechanism allowing producers to gain a competitive advantage over neighboring strains within the environment (Fajardo, 2008). Secondly, bacteriocins can directly inhibit the growth of pathogen, and finally, bacteriocins may serve as signaling peptides or quorum-sensing molecules. This allows populations of bacteria to synchronize group behavior and facilitate a coordinated multicellular functionality. (Fajardo, 2008)

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Jonathan Frye for his support and advice. I also thank the McPherson College Natural Science Department for the necessary funds to complete this project.

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