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Antibacterial properties of aqueous extract *Curcuma longa* on *Streptococcus pyogenes* and *Escherichia coli*

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ABSTRACT

Plants have been known for having medicinal properties and have long been used by many countries. The intention of this study was to find a potential lead on the possibility of using *Curcuma longa* as a new antibacterial agent. To do this, aqueous extracts of turmeric were made by using turmeric rhizomes and boiling deionized water. Agar plates containing *S. pyogenes* and *E. coli* were prepared and the disc diffusion method was used to study the bacterial effects. Although, previous studies have given results of turmeric extracts being antibacterial to some bacteria, this study did not produce similar results on *S. pyogenes* and *E.coli*. More research and analysis could determine if the antibacterial agent (curcumin) did not dissolve in the deionized water solution thus making the solutions used not antibacterial.

Keywords: *Aqueous extract, Curcuma longa, Escheria coli, Streptococcus pyogenes, Turmeric.*

INTRODUCTION

Plants have long been known for having medicinal properties such as anti-inflammatory, antibacterial, antioxidant, and much more. In fact, 80% of the world is dependent upon plant remedies as the main form of healthcare (Paray, 2018). With India being the largest producer of medicinal plants, the country has seen an increase of scientific studies with herbs (Gupta et al., 2015). One plant that is used in medicine as well as in the kitchen is Curcuma longa (Turmeric) belonging to the Zingiberaceae family and is a rhizomatous shrub that is native to India (Gupta et al., 2015). This is the herb that makes curry its famous orange color and has been used in Asian cooking for centuries. Turmeric has also been used in various ways medicinally. Turmeric supplements can be found at many local grocery stores with labels claiming the substance to promote general wellness.

Plants being used medicinally is becoming popular worldwide because some see plants as a safer alternative to over the counter prescriptions (Upadhyaya et al., 2018). With that being said, not all plants, spices, or herbs are helpful, some could be harmful (Chandarana et al, 2004). It has been found that the commercial essential oil of turmeric contains many impurities that inhibit the antimicrobial effects (Antunes et al, 2012). Some other studies, involving curcuminoid and oil extracts have been able to show antibacterial properties (Naz et al., 2010) and a crude aqueous extract solution proved to be antibacterial on the following bacteria: Escherichia coli, Staphylococcus aureus, and Streptococcus agalactiae (Paray, 2018).

Shiga toxin producing *E. coli* (STEC) has been known for foodborne outbreaks (Baoguang et al, 2017). Shiga toxin producing *E. coli* is a strain of bacteria that is pathogenic- it causes illness. This bacterium is easily spread through contaminated food or water or physical contact. Humans experience negative symptoms such as the illness known as food poisoning when exposed, but some animals exposed to this bacterium such as sheep and cows are not affected (Kintz et al, 2016).

Group A streptococcus, also known as Streptococcus pyogenes, is another bacterium that is harmful to humans. This bacterium is most known for causing the sore, swollen throat and the illness “strep throat” (Church et al, 2018). This bacterium is one of the most studied. This specific strain is only found in humans (Horstmann, 2018).

These bacteria were chosen for my study because they are both pathogenic in humans. If turmeric aqueous extract proves to be antibacterial to these bacteria, with more research, this method of extraction could potentially be used to produce an antibiotic in the future.

MATERIALS AND METHODS

Turmeric in the form of an aqueous extract will be used in this experiment. To prepare this extract, organic raw turmeric rhizomes were purchased. Two different preparations of the rhizomes were made into two solutions. The first solution was prepared by first chopping the rhizomes in approximately 1cm pieces and then placed in an oven of about 90 degrees Celcius for 48- hours, to remove all water. The rhizomes were then transferred into a blender to create a powder. 15.63 grams of the powder was then mixed with 150mL of deionized water (Paray et al., 2018) and was heated on a hot plate set to about 250 degrees Celsius and allowed to “brew” for fifteen minutes. The second solution was prepared by chopping 16.03 grams of rhizomes in approximately 1cm slices and immediately, transferring into a

beaker with 150mL of deionized water on a hot plate set to about 250 degrees Celsius and allowed to "brew" for fifteen minutes. A third solution was made by using McCormick brand organic turmeric powder that was purchase from the local grocery store. 15.02 grams were weighed out and placed directly into a beaker containing 150 mL of deionized water. The beaker was then placed on a hot plate set to 250 degrees Celsius and allowed to brew for fifteen minutes.

The bacteria used in this experiment were Streptococcus pyogenes and Escherichia coli. Both of these bacteria were purchased from Carolina.com. Nutrient agar plates were prepared from nutrient agar that was autoclaved for sterilization to be used for *E. coli*. Since *S. pyogenes* is a gram positive bacteria and gram positive bacteria thrive in blood, 5% sheep blood plates were purchased from Carolina.com to be used for this bacteria. The plates were divided into four sections, by drawing lines on the outside of the plate with a sharpie. For the experiment, a 24 hour culture of each bacteria was cultivated in separate test tubes, but both were incubated in nutrient broth. Ten microliters of each was pipetted on the plates and spread uniformly. Sterile filter papers were inoculated with 2000 microliters of each of the above solutions (sundried, oven dried, and raw) as well as water for the control. One filter paper of each solution was placed one of quadrants of the petri dish and was labeled accordingly. After 24 hours of incubation at 37º Celsius, the zone of inhibition was observed and taken in measurement of milliliters.

RESULTS

Using the above method, *Curcuma longa* showed to no effect on the bacteria *E. coli* and *S. pyogenes*. This is concluded because after the experiment was conducted, there were no observable zones of inhibition on any of the plates of bacteria, even though according to previous research, turmeric has been proven to be antibacterial in some studies against *S. pyogenes* (Kumar et al., 2001) and *E. coli* (Paray et al., 2018).

DISCUSSION

To investigate the antibacterial properties of *Curcuma longa,* aqueous extract solutions were prepared in three different scenarios. Previous research has proved that an essential oil extract of turmeric can be resistant to the following bacteria: *E. coli*, *S. aureus, P.aeruginosa* (Teles et al. 2019). In other research, crude aqueous extracts were taken and antibacterial properties were evaluated on bacterial pathogens *E.coli* and *S. aureus.* Contrary to the results in this study, the aqueous extracts proved to be susceptible to various bacteria, including the two used in this study (Paray et al. 2018).

The results in this experiment were not consistent with previous studies. Both bacteria were resistant to the raw turmeric solution, the oven dried solution, and the store bought powder solution. There were no zones of inhibition to be measured. To further this study, more trials should be repeated to ensure similar results each time. Another way to test this study would be to order turmeric rhizomes from various places as well as grow them in lab in order to control the environment that the rhizomes grow in. This would provide insight as to whether or not the environment the rhizome is grown in effect the antibacterial properties the root has.

Another possible reason for the results that were obtained in this study, is the "brew" time not being long enough. In a different study, the aqueous solutions were in a warm oven "overnight," (Paray et al., 2018). This may suggest that the molecule that served to be antibacterial in the other study doesn't immediately go into an aqueous solution and 15 minutes in hot water was not adequate time in my study.

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