

Comparison of chemical compounds, antioxidant and antimicrobial effects of Camellia sinensis black tea and green tea essential oil and leaf extract on plant pathogenic bacteria (*Xanthomonas campestris* and *Pseudomonas syringae*) and human pathogenic bacteria (*Staphylococcus aureus* and *Escherichia coli*)

Masoud Haidarizadeh^{*1}, Fatemeh Alijani², Morahem Ashengroph³, Sajjad Atashi⁴

^{1*} Corresponding Author. Assistant Professor of Plant Physiology, Department of Biological Science, Faculty of Science, University of Kurdistan, Sanandaj, Iran

^{4,2}M. Sc in Cellular and Molecular Biology, Department of Biological Science, Faculty of Science, University of Kurdistan, Sanandaj, Iran,)

³ Associated Professor of Microbiology, Department of Biological Science, Faculty of Science, University of Kurdistan, Sanandaj, Iran,).

E-mail (m.haidarizadeh@uok.ac.ir r)

Accepted: 2023.6.19

Received: 2022.12.12

Introduction:

Plants have a very valuable capacity to produce many medicines, pesticides and natural preservatives in food products and have the ability to replace synthetic products polluting the environment. Indiscriminate use of antibiotics has gradually created resistance in pathogenic microorganisms. Therefore, identifying and introducing new natural antibacterial sources against these human and plant pathogens is important and a research necessity. Based on this, the present study was designed to evaluate and compare the antimicrobial and antioxidant effects of black tea and green tea.

The aim of our research program was to identify and introduce natural compounds with antimicrobial effects against these four pathogenic bacteria. Comparing the antibacterial effects and antioxidant properties of black tea and green tea, as well as investigating the sensitivity and resistance of plant pathogens (*Xanthomonas campestris* and *Pseudomonas*

syringae) and human pathogens (*Staphylococcus aureus* and *Escherichia coli*) to the antibacterial effects of black tea and Green tea is one of the goals of this research. There was no report on the evaluation of the antibacterial effects of green and black tea against plant pathogenic bacteria (*Xanthomonas campestris* and *Pseudomonas syringae*).

Materials & Methods:

The prepared samples of Iranian black tea and green tea after complete washing in the shade were dried and ground with a ratio of 10 grams per 100 cc of solvent (pure methanol (Merck) or double distilled water according to the case) using an extract extractor. The extracts were concentrated with the help of a rotary distillation device (Tecan sunrise model) at a temperature of 60 degrees Celsius, complete removal of the solvent, in a glass container and under a hood. Different concentrations were prepared from the remaining dry matter according to the experiment. A fresh extract was prepared for each of the experiments.

In this research, aqueous and methanol extracts of Iranian black and green tea leaves were prepared and the compounds in them were identified and measured by GC-Mass. Antibacterial effects were measured and compared by disk diffusion and minimum inhibitory concentration (MIC) methods and antioxidant properties by DPPH method.

Results & discussion:

According to the results of this research, the main component of green tea extract includes caffeine (82.97%), and the main component of black tea extract is caffeine (86.25%). Caffeine in black tea is three and a half percent more than in green tea. Caffeine in both extracts has the highest percentage and is the most compound. The antioxidant properties of green and black tea extracts are comparable to vitamin C. The antioxidant properties of green tea are significantly higher than black tea. The capacity to inhibit free radicals at a concentration of 100 grams per liter of black tea and green tea extracts is almost equal to the capacity to inhibit free radicals at a concentration of 0.176 grams per liter of pure vitamin C. The data related to EC50 shows that the free radical scavenging capacity of green tea is 28.857 g/liter, 1.53 times that of black tea, 44.222 g/liter. That is, the antioxidant property of green tea is one and a half times that of black tea. The minimum inhibitory concentration of green tea extract against *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas syringae* with a concentration of five mg/liter is significantly three times higher than the inhibitory concentration of black tea extract with a concentration of fifteen mg/liter. The minimum inhibitory concentration of green tea extract against *Xanthomonas campestris* with a

concentration of one mg/liter shows that this bacterium shows the most sensitivity to green tea extract and the inhibitory power of green tea extract against *Xanthomonas campestris* is significantly higher than three another bacterium. The minimum inhibitory concentration of black tea extract against *Pseudomonas syringae* with a concentration of five mg/liter is significantly higher than the inhibitory concentration of black tea extract against *Escherichia coli*, *Staphylococcus aureus*, *Xanthomonas campestris*. The minimum inhibitory concentration of black tea extract against *Pseudomonas syringae* with a concentration of one mg/liter shows that this bacterium shows the most sensitivity to black tea extract and the inhibitory power of black tea extract against *Pseudomonas syringae* is significantly higher than three another bacterium.

Caffeine is the main component of green and black tea extracts. The minimum inhibitory concentration of green tea extract against *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas syringae* is significantly three times higher than that of black tea extract. The inhibitory capacity of green tea extract against *Xanthomonas campestris* and the inhibitory capacity of black tea extract against *Pseudomonas syringae* is significantly higher than the other bacteria. Many of the effects related to green and black tea can be considered related to the relatively high capacity of inhibiting free radicals. The results of this research showed that the free radical and antioxidant capacity of green tea is significantly one and a half times higher than black tea. The inhibitory ability of the extract against plant pathogens is relatively and significantly higher than human pathogens. Different products and perhaps the waste of black tea and green tea can be used to control harmful microorganisms.

Conclusion:

the antioxidant property of green tea is significantly higher than that of black tea. The antioxidant property of green tea is one and a half times that of black tea. The minimum inhibitory concentration of green tea extract against *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas syringae* is significantly three times higher than that of black tea extract. *Xanthomonas campestris* bacteria showed the highest sensitivity to green tea extract and the inhibitory power of green tea extract against *Xanthomonas campestris* is significantly higher than the other three bacteria. *Pseudomonas syringae* bacteria showed the highest sensitivity to black tea extract and the inhibitory power of black tea extract against *Pseudomonas syringae* is significantly higher than the other three bacteria.

Keywords: antioxidant, antibacterial, inhibitory

Acknowledgment:

This article is a part of the master's thesis of Fatemeh Alijani with the supervision of Dr. Masoud Haidarizadeh and advising of Dr. Morahem Ashengroph, members of the Department of Biological Science, Faculty of Science, University of Kurdistan,

Declaration of conflict of interest:

The authors declare that there is no conflict of interest.

Statement on ethics:

We certify that the submission is original work and is not under review at any other publication.