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Effectiveness of the Alcoholic Fruits Extract of Ficus *Carica* L. on Pathogenic Bacteria

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Annotation: The objective of this article is assess the inhibitory potential of fig fruit extract against several bacterial pathogen. Use of the naturals products for their antimicrobial properties has been interest in the recent past. The aims of this work evaluate the ability of the fruits alcoholic extract of F. carica in eliminating some disease-causing bacteria. The extract was prepared using ethanol as a solvent and it was tested against bacterial strains such as E. coli, Staph. Aureus, P. aeruginosa, S. typhi. The results demonstrated significant antimicrobial activity, indicating fig fruit extract has potential to be used in combating bacterial infections. Study results also revealed that the higher concentration of the extract was more effective in inhibiting bacterial growth, table (1).

Keywords: Fig-Fruits, Alcoholic-Extract, Medical-plants, Anti-microbial, Pathogenic-Bacteria.

Introduction

The rise of antibiotic-resistant bacteria has brought alarming consideration in the entire globe about public health. Pathogenic bacteria, such as *Staph. aureus*, *E. coli*, and Salmonella species are accountable for major infections with high morbidity and mortality rates causing all these problems across the world. This situation is raising a call for new sources of anti-microbial agents

that would mainly be explored from natural resources. It is nutritionally potential fruit that has been traditionally claimed to have anti-microbial activity among its various health benefits. The fig tree (*Ficus carica*) is an ancient medicinal plant belonging to the family Moraceae and has been used since time immemorial by different cultures for various ailments (Fig. 1) (Jeong , *et al*., 2009). Fig fruits contain bioactive compounds such as phenolics, flavonoids, and organic acids that are assumed to be responsible for effects related to treatment (Serrano , *et al*., 2006). The fascinating anti-microbial properties found in plant extracts spring from a treasure trove of phytochemicals, with alkaloids, flavonoids, tannins, and terpenoids leading the charge. These remarkable compounds wield their power in some truly diverse and multi-faceted ways : they can seep through the tough barriers of microbial cell walls, intervene in nucleic acid synthesis, and disrupt essential metabolic processes, creating a robust defense against harmful pathogens (Cowan , 1999). Digging deeper, prior studies have unveiled that various parts of the fig plant—be it its lush leaves, hearty stems, or succulent fruits—hold significant anti-bacterial potential capable of combatting a wide array of bacterial strains (Parekh, *et al*., 2005).

Figs have been used in traditional medicine for centuries, with various part of the plant , including the leaves and fruits, being used for their therapeutic effects (sadeghi et al., 2019). Recent studies have shown that fig fruits contain bioactive compounds, including flavonoids , phenols , tannins, contribute to their antioxidant and antimicrobial events (Akinmoladun *et al*., 2019). The alcoholic extract of fig fruits, in specific, has received important attention due to its high attention of these bioactive components, which may enhance its antimicrobial effectiveness against pathogenic microorganisms. The mechanism of antibacterial activity of alcoholic extracts is hypothesized to include description of bacterial cell membrane, inhibition of enzyme activity, and interference with bacterial metabolism (González-Burgos, *et al*., 2011). Studies have shown that different concentrations of fig extracts can inhibit the growth of pathogenic bacteria, suggesting their potential use as natural preservatives or therapeutic agents in the food industry and clinical fields (Fadel , *et al*., 2020). Moreover, figs contain many essential nutrients, including vitamins, minerals, and dietary fiber, which may contribute to improved overall health. Their high antioxidant content is associated with a reduced risk of chronic diseases, making them a valuable addition to the human diet (Pérez-Jimenez and Nevo, 2016).Given the cumulative antibiotic resistance and the need for another treatments , discovering the antimicrobial potential of fruits fig extracts represents a promising area of this study.

Several studies have indicated the antimicrobial effects of fig fruit extracts against various pathogenic bacteria. For example, a study by Ezaat, *et al*. (2020) showed that alcoholic extracts of fig fruits exhibited important anti-bacterial activity against *Staphylococcus aureus* and *Escherichia coli*, (Benkebelia, 2018), highlighted the potential of fig extracts to inhibit the growth of Salmonella species, suggesting its effective-ness as a natural anti-microbial agent. Despite the promising results, additional research is needed to explain the specific apparatuses underlying the anti-bacterial properties of fig fruit extracts. In addition, the safety and efficacy of these extracts need to be evaluated finished clinical trials to control their potential therapeutic requests (Kumar, *et al*., 2019). Understanding the synergistic effects of fig extracts with other anti-microbial agents may also enhance their efficacy and expand their application in clinical settings and food protection.

Fig. (1) fruits and leaves of *Ficus carica* used.

Materials and Methods

Preparation of Fig Fruit Extract

Ripe figs were picked, washed & dried. The dried fruits were then ground in to affine powder. About 100g of powder was extracted with 500ml of 70 % ethanol for 48h with intermittent shaking. The mixture was then filtered and the filtrate was concentrated to dryness under vacuum, using a rotary evaporator. The dried extract was kept at 4°C until use (Saeed *et al.* , 2006).

Strains and Culture Conditions Bacterial

These bacterial strains examined were *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeruginosa* (ATCC 27853), and *Salmonella typhi* (clinical isolate). Bacteria were grown in nutrient broth at 37°C and subculture on nutrient agar slopes (CLSI, 2012).

Antibacterial Assay

The study on the antibacterial activity of the fig fruit extract was carried out by employing the agar well diffusion technique. Preparing the Mueller-Hinton agar plates, a sterile swab was used to inoculate the test bacteria. Cylindrical holes with a diameter of 6 mm were made on the agar using a sterile corn borer and 50 µl of the fig extract at 50, 100, and 200 mg/ml concentrations were equally added to the wells. Ethanol 70% was used as the negative control while standard antibiotics ciprofloxacin for the gram negative beings and vancomycin for the gram positive beings were used as the positive controls. The plates were afterwards incubated at 37°C for 24 h and the zones of inhibition were measured (Bauer, *et al.* , 1966).

Qualitative phytochemical analysis of Garlic extract

Chemical analysis was carried out in an attempt to ascertain the existence of active compounds like alkaloids, tannins, saponins, phenols, glycosides, phlobatannins, flavonoids and glycosides as explained by (Sofowora, 1993 ; Trease and Evans, 1989).

1. **saponins Test:** In a test tube, 2 milliliter of the aqueous and ethanolic extracts was mixed for two minutes. Foaming that continued on shaking was considered as evidence of saponins.

2. **Alkaloids Test:** Five milliliters of both aqueous and ethanolic extracts were treated with 5 ml 1% HCl in a water bath for twenty minutes at intervals. The precipitate formed was allowed to cool and then filtered and a few drops of Mayer's reagent/picric acid were added to the filter. It has also been proven that the alkaloid is present in the precipitate if it is in the form of a cream.
3. **Phenolic Test:** 5 ml of the crude extract was taken in a test tube and two drops of 5% ferric chloride were added. Phenolics were indicated by the presence of greenish precipitate.
4. **Tannins Test:** To the prepared extracts, 1 ml of freshly prepared 10% potassium hydroxide solution was added to a volume of 1 ml. The formation of a dirty white precipitate upon emergence of the solution was evidence of the presence of tannins.
5. **Steroids Test:** 5 drops of tetraoxoisulfate acid VI were added to 1 ml of extracts. A color change to red means the presence of steroids.
6. **Flavonoids Test:** 1 ml of 10% sodium hydroxide was added to 3 ml of extract. The yellow color also indicates the presence of flavonoids.
7. **Glycosides Test:** 2 ml of chloroform was added to 3 ml of extract. The material was carefully dissolved in acid tetraoxysulfate VI to form a substrate. Reddish-brown color indicates the presence of glycosides.

Results

Detection of bioactive chemical compounds

Table (1) showing presence and absence of bioactive compounds in the plant extracts, (+) means presence of compound and (-) absence of it:

Bioactive compounds	Alkaloids	Tanins	Glycosides	Flavonoids	Steroids	Saponin	Phenols	Terpenoids
+ -	-	+	+	+	+	-	+	+

Effect of Alcoholic extracts on Fungi growth

The alcoholic extract of fig fruits exhibited significant antibacterial activity against all tested bacteria. The inhibition zones for *E. coli* were 12 mm, 15 mm, and 18 mm at concentrations of 50, 100, and 200 mg/ml, respectively. For *S. aureus*, the zones were 14 mm, 18 mm, and 22 mm. *P. aeruginosa* showed inhibition zones of 10 mm, 13 mm, and 16 mm, while *S. typhi* exhibited zones of 13 mm, 16 mm, and 19 mm. The negative control showed no inhibitory effect, while the positive controls produced zones of inhibition comparable to the highest concentration of the fig extract (Table 2).

Table 1: show Effect of alcoholic extract of *Ficus carica* fruits on the Growth of Pathogenic Bacterial Strains (mm)

Bacterial species	Alcoholic Extract of Fig Fruits		
	Concentrations mg/ml		
	50 mg/ml	100 mg/ml	200 mg/ml
Escherichia coli	**12**	**15**	**18**
Staphylococcus aureus	**14**	**18**	**22**
Pseudomonas aeruginosa	**10**	**13**	**16**
Salmonella typhi	**13**	**16**	**19**

Discussion

Alcoholic extracts are more effective in inhibiting bacterial growth (Mustafa & Oday, 2020), so only alcohol was used for extraction in this study. From the results it can be concluded that the alcoholic extract of fig fruits has high anti bacterial activity against both Gram positive and Gram negative bacteria. The anti microbial properties of figs are likely attributed to their content of bioactive compounds , including flavonoids, phenols, and tannins (Solomon, *et al*., 2006). The higher inhibition zones observed with increasing extract concentrations indicate a dose dependent anti bacterial effect.

Conclusion

This study demonstrates the potential of alcoholic fig fruit extract as an effective anti bacterial agent against a range of pathogenic bacteria. Further research is required to isolate and characterize the specific compounds responsible for their anti microbial activity, and to evaluate their efficacy in vivo.

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Conflict of Interest: None.

Ethical Issues: None.

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