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Exploring the Pharmacological Properties of Mirabilis Jalapa: Phytochemical and Antimicrobial Insights

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Abstract: *The antibacterial properties of the aqueous and ethanolic extract made from the leaves of the white-flowered plant Mirabilis jalapa L. were tested against Salmonella typhi, Escherichia coli, Vibrio cholerae, Bacillus subtilis, and Staphylococcus aureus. The examined microorganisms showed no inhibition from aqueous extracts. All of the ethanolic extracts, however, demonstrated strong antibacterial activity against the chosen pathogens. Tetracycline's activities, which were used as a standard (100%), were used to compute the growth inhibitions (%). Additionally, the methanolic extract of the white-flowered plant contains a small quantity of tannins, moderate amounts of alkaloids, carbohydrates, terpenes, and saponins, according to the qualitative phytochemical screening. Flavonoids and glycosides were not found in significant quantities. The methanolic extract's pH was determined to be neutral. The study unequivocally showed that M. jalapa's white-flowered plant has high antibacterial properties and is effective against a variety of microbes.*

Keywords: Antibacterial activities, phytochemical screening, and Mirabilis jalapa

I. INTRODUCTION

The tall herbaceous climbing plant Mirabilis jalapa (Nyctaginaceae) is grown as an attractive plant all across the nation. It has opposite leaves, huge, spectacular flowers, coriaceous obovoid fruits, and noticeable tuberous roots (Ghani, 2003). According to Encarnaci´on et al. (1998), M´arquez et al. (1999), Holdsworth (1992), Comerford (1996), Moreira (1996), and others, M. jalapa is used in traditional medicine by people from various countries to treat conditions like diarrhea, dysentery, conjunctivitis, edema, inflammation, swellings, muscular pain, and abdominal colic. Numerous researchers have reported that M. jalapa extract has a variety of bioactivities, including antibacterial (Kusamba et al., 1991), antiviral (Vivanco et al., 1999), antifungal, antimicrobial (De Bolle et al., 1996; Encarnaci´on et al., 1998; Dimayuga, 1998; Oskay and sari, 2007; Hamill et al., 2003), antinociceptive (Walker et al., 2008), cytotoxicity and antioxidant activity (Rumzhum et al., 2008), antigonorrheal (Caceres et al., 1995), and antispasmodic (Cort´es et al., 2004). The root and aerial parts of this plant have yielded a number of constituents, including some rotenoids, a derivative of isoquinoline, terpenoids, steroids, phenolic compounds, D-glucoside, ursolic acid, mirabalisoic acid, trigonellin, an antiviral protein, alanine, alphaamyrins, arabinose, beta amyrins, campesterol, daucosterol, and dopamine (Vivanco et al., 1999; Yi-Fen et al., 2002; Asprey and Thornton, 1955; Stanic et al., 1988; Siddiqui et al., 1990; Ali et al., 2001; Yang et al., 2001; Wei et al., 2003). There are recognized range variations of M. jalapa, which are often distinguished by the color of their flowers. The particular flowered species' (white flowered plant's) leaves are customarily used as poultices for persistent warts and swellings. Therefore, it was determined to assess the impact of this specific species on phytochemical screening and antibacterial activity.

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Figure 1. White flowered plant of M. jalapa.

II. MATERIALS AND METHODS

Plant As shown in Figure 1, fresh leaves of the white-flowered M. jalapa plant were gathered in November from Abbottabad, Pakistan. Professor Dr. Habib Ahmad used the Hazara University herbarium in Mansehra, Pakistan, to identify the specimens. Making the extracts After being cut into tiny bits and ground into a fine powder, the shade-dried plant material weighed 80 g three times. After that, each was extracted for around four weeks in separate methanol and water ethanol. Separate filters and lower pressure evaporation of each extract produced a gum (6 to 10 g aqueous, 3 to 5 g ethanolic, and 3 to 5 methanolic). Antimicrobial properties Using the agar well diffusion technique, the aqueous and ethanolic extracts were tested against the human pathogens Bacillus subtilis, Salmonella typhi, Escherichia coli, Vibrio cholera, and Staphylococcus aureus (Attaurrahman et al., 2000). The Khalid et al. (2011) technique was used to produce media. A broth culture of the same bacteria was used to swab nutrient agar plates for two to eight hours. In each of these plates, a sterile metallic borer was used to cut wells (6 mm in diameter) in the medium, with the centers spaced at least 24 mm apart. Then, using sterile dropping pipettes, samples (100 mg/ml) and standard tetracycline (100 mcg/ml) were introduced to their corresponding wells. Tetracycline, which was used as a standard (100%), was compared to the antibacterial activity of M. jalapa extract against the chosen microorganisms. Every growth inhibition (%) was computed in relation to tetracycline's actions utilizing
the formula:

$$\text{Inhibition (\%)} = 100 - \frac{zone\,of\,inhibition\,of\,the\,sample\,(mm)}{zone\,of\,inhibition\,of\,the\,Std\,(mm)} \times 100$$

Analysis of phytochemistry Using straightforward qualitative techniques, Ullah et al. (2011) screened the methanolic extract of the white-flowered plant of M. jalapa for the presence of alkaloides, glycosides, terpenes, saponins, tannins, flavonoids, and carbohydrates. Additionally, the two extracts' pH values were noted.

III. RESULTS

Antibacterial activities of white flowered M. jalapa leaves have been evaluated in vitro against S. aureus, S. typhi, E. coli, V. cholera and B. subtilis. Aqueous extracts did not show any inhibition against the germs under test. The white-flowered plant of M. jalapa's ethanolic extract, however, demonstrated the greatest inhibition against S. typhi (54.74%), followed by S. aureus (54%), V. choera (51.95%), E. coli (51.08), and B. subtilis (50%). Tetracycline activities, which were used as a standard (100%) as shown in Table 1, were used to compute the growth inhibitions (%). Table 2 shows the results of the qualitative chemical screening of the methanolic extract of the white flowered plant, which shows a high content of tannins and a moderate quantity of alkaloids, carbohydrates, terpenes, and saponins. Flavonoids and glycosides were not found in significant quantities. The methanolic extract's pH was found to be neutral.

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Table 1. Anti bacterial activities of white flowered specie of *M. jalapa*.

Extraction base	Inhibition with respect to standard drug, tetracycline (%)				
	S. aureus	*S. typhi*	*E. coli*	*V. cholera*	*B. subtilis*
Water	0	0	0	0	0
Ethanol	54	54.74	51.08	51.95	50
Tetracycline	100	100	100	100	100

Table 2. Phytochemical screening of methanolic extract of white flowered plant *M. jalapa*.

Test	Observation	White flowered *M. jalapa*
Alkaloids: Extract + 10% tannic acid solution	Turbidity/precipitation	++
Saponins: Extract vigorously shaken in a test tube for 2 min	Frothing less than 1 cm	++
Flavonoids: (Shinoda test) Ethanolic extract + magnesium fillings + conc. HCl	Pink or red color	-
Tannins: Extract + few drops of $FeCl_3$	An immediate green precipitate formed	+++
Terpenes: Decolorized extract residue + chloroform + acetic anhydride + conc. H_2SO_4	Brown precipitate formed	++
Carbohydrates: Extract + Molisch's reagent + conc. H_2SO_4	Purple precipitate	++
Glycosides: Extract + Fehlings reagent and boiled for 2 min	Brick red color	-

IV. DISCUSSION

The presence or absence of an inhibitory zone, as shown in Table 1, was used to evaluate the antibacterial properties of the extracts, both aqueous and ethanolic. The study unequivocally shown that M. jalapa is a useful medicinal plant with strong antimicrobial properties against a variety of bacteria (Oladunmoye, 2007). According to Oladunmoye's (2007) assessment, the antimicrobial activity of M. jalapa has been known since ancient times (Encarnaci´on et al., 1998; Vivanco et al., 1999; Kusamba et al., 1991; De Bolle et al., 1996; Oskay and Sari, 2007; Dimayuga, 1998). The ethanolic extract of M. jalapa leaf was tested against five pathogenic bacterial strains: E. coli, S. aureus, S. typhi, B. cereus, and K. pneumoniae. The present investigation indicated that the zone of inhibition assessed against S. typhi and E. coli was 16.20 and 16.00 mm, respectively, while the maximum zone of inhibition of leaf extract was 13.0 mm and the lowest was 4.0 mm. Therefore, it has been shown that the white-flowered plant of M. jalapa is effective against E. coli, which causes urinary tract infections, traveler's diarrhea, and other harmful diseases, and S. typhi, which causes typhoid fever. Additionally, it was noted that none of the examined bacterial strains—namely, Pseudomonas testosteroni, Klebsiella pneumoniae, Myotis flavus, Proteus morganii, B. subtilis, and Staphylococcus epidermidis—were inhibited by either aqueous or methanolic extracts of M. jalapa (Nair et al., 2005). The ethanolic extract of white flowered M. jalapa was shown to inhibit B. subtilis, however the aqueous extracts in the present investigation did not exhibit any inhibitory effect. This might be due to the antimicrobial peptides, which may not be soluble in water. The best conclusion from the current study is that this species, white flowered M. jalapa, is also active against B. subtilis and can be used to find bioactive natural products that could be used as leads for the development of new pharmaceuticals against diseases caused by B. subtilis. The zone of inhibition measured was 16.30 mm. High levels of tannins, which have been shown to have potential antiviral (Lu et al., 2004), antibacterial (Akiyama et al., 2001), and antiparasitic effects (Kolodziej and Kiderlen, 2005), were found in the phytochemical investigation. Finding the clinical utility of a certain species, that is, a specific flowering plant, was the primary goal of the research. Such screening of different natural organic compounds, as well as the identification of active agents and the most effective form, is urgent needs. According to the findings of this study, we can use this species of M. jalapa to produce antimicrobial agents that are more effective against the necessary pathogens, particularly B. subtilis, which can cause food contamination and food poisoning.

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