The anti-fungal effects of aqueous-extract of *Malva sylvestris* against three medically important fungi of skin and nail in humans

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Abstract

The current study was conducted to evaluate the anti-fungal effects of aqueous-extract of Malva sylvestris (AEMS), a plant known as mallow, against three medically important fungi of skin and nail in humans. The study was focused on the use of locally-collected leaves that were subjected to an aqueous-extracting method. The extracted solution was dry-transformed into powder, which later was solution-based utilized as a triplicate for each of 1, 5, 10, 15, 20, and 25mg/ml in a potato dextrose agar (PDA) medium against the growth of Trichophyton mentagrophytes, Trichophyton rubrum, and Epidermophyton floccosum, three medically important fungi that cause skin and nail infections in humans. Two controls were used, a negative-control that contained nothing but the fungi (NC) and a positive-control that included 2mg/ml clotrimazole, an antifungal solution, and the fungi (PC). After 2-3 weeks of cultivation, the results revealed that the growth inhibition percentages were 5.19, 6.45, 40% against T. mentagrophytes, T. rubrum, and E. floccosum, respectively. The inhibition rate reached up to 100% against all fungi at 25mg/ml of AEMS. The study findings indicate important effects of Malva sylvestris aqueous-extract against the growth of skin and nail fungi of humans.

Keywords: Anti-fungi, mallow, Malva sylvestris.

Introduction

Since the existence of human beings on the earth, they used medicinal plants and herbs for all diseases and pain. According to the rapid progress of science and technology, scientists are able to develop the knowledge and use of plants and herbs in the alternative medicine (1); however, at the present time, herbs have been achieved a high level of attention, after phytotherapy has become based on scientific foundations. These herbs contain important active substances, such as flavonoids, with a wide-range of activity against different illnesses (2). The effect of drugs, upon entering the body, is not limited to the sickness-affected cells only, but also affects several healthy organs at the same time. This effect leads to the accumulation of these pharmaceutical substances as well as their residues inside the body, which causes disturbances in the metabolic pathways. Also, pharmaceutical compounds can disturb the functions of the body, such as in the case of the over production of oxygen free radicals (OFRs) that leads to body systemic damage (3).

The use of medically important herbs can eliminate or inhibit over generation of OFRs through the anti-oxidative stress activity. Across many decades, a large number of pharmaceutical drugs were produced from important plants, which were used to treat different illnesses. Many studies revealed that herbs contain some critical bioactive substances, such as tannins, terpenoids, alkaloids, and flavonoids, that can be extracted to treat a wide-range of infections caused by microorganisms, such as bacteria (4–6).

The effectiveness of herbal remedies is controversial because it lacks quantitative knowledge of its active ingredients. One-clear evidence of the importance of herbs is that many antimicrobial drugs were found to be generated from microorganism products (7,8); however, it was detected later on that there are many microorganisms developed resistant to these antibacterial substances, making them ineffective and as a result, some of them lost their therapeutic properties (9–11). As a result of these reasons, most of the modern scientific research tended to search for alternative treatment for diseases that depend on industrial chemicals, such as the use of plant-derived substances, which provide effectiveness, safety, and economic feasibility (12,13).

The *Malvaceae* family includes a wide variety of plants native to both the tropics and the temperate zones of both hemispheres. Many uses have been found for species of this family in farming, forestry, and gardening. They include the valuable ornamental varieties; Hibiscus and Alcea, as well as the food crops, such as okra (Abelmoschus esculentus), and cotton (Gossypium spp.). There are 244 genera and over 4225 recognized species that belong to this family. Malva genus-II. The genus *Malva* includes about 30 species that grow in many countries of the world (14,15).

In the case of medicinal significance, mallow (*M. sylvestris*) was used in traditional medicine as an antiseptic and anti-bacterial and anti-fungal substance. It was also considered as a deworming substance for some human intestinal helminths, especially Ascaris, hookworms, and others (16).

The current study was conducted to evaluate the anti-fungal effects of aqueous-extract of AEMS, a plant known as mallow, against three medically important fungi of skin and nail in humans.

Materials and methods

Preparation of *Malva sylvestris* aqueous-extract

The AEMS was prepared by mixing 20gm of crushed plant for each sample separately with 400ml of distilled water in a volumetric flask with a capacity of 1000 ml, then leaving the suspension in a water bath rocking at a temperature of 40°C for 24hrs, and later filtering of the suspension using several layers of medical gauze. Then, sterilization and filtration methods were performed through 0.22µm filter papers. The sterilized filtrate was collected in a sterile glass vial and placed in a flat glass dish in an oven at 40˚C for 48hrs until the precipitate of the filtrate became a powder sticky to the glass. Then, scraping and collecting of the powder was done in a tightly closed glass container and was kept, after weighing, in a refrigerator until use. The process was repeated several times to get a sufficient amount of the extract.

Antifungal effects of *Malva sylvestris* aqueous-extract

The inhibitory effectiveness of the plant extracts on the growth of the studied fungi, *T. mentagrophytes*, *T. rubrum*, and *E. floccosum*, was examined, in which the dry powder was used as solution in a triplicate for each concentration of 1, 5, 10, 15, 20, and 25mg/ml in a PDA that was left to harden. After that, *T. mentagrophytes*, *T. rubrum*, and *E. floccosum* were added to the medium plates in the middle. Two controls were used, a negative-control that contained nothing but the fungi (NC) and a positive-control that included 2mg/ml clotrimazole, an antifungal solution, and the fungi (PC). All plates were placed in an incubator for 2-3 weeks at 25-28˚C. The following equation was used to calculate the growth inhibitory percent (GIP):

$$GIP = \frac{GIDMPC - GIDMAEMS}{GIDMPC} \times 100$$

Where is GIDMPC: Growth inhibitory diameter mean for the control

GIDMAEMS: Growth inhibitory diameter mean for the AEMS

Statistical analysis

One-way ANOVA was used to process and analyze the data. Mean and Standard error of mean (SEM) was recruited for the analysis and display of processed data. *P* of less than 5% was used for determination of any significance. Graphs and data analysis were generated using GraphPad prism v7.00 (GraphPad Inc., USA).

Results

After 2-3 weeks of cultivation, the results revealed that the growth inhibition percentages were 5.19, 6.45, 40% against *T. mentagrophytes*, *T. rubrum*, and *E. floccosum*, respectively. The inhibition rate reached up to 100% against all fungi at 25mg/ml of AEMS (Figure 1). These increases were significantly (*p*<0001) high in decreasing the growth of the tested fungi.

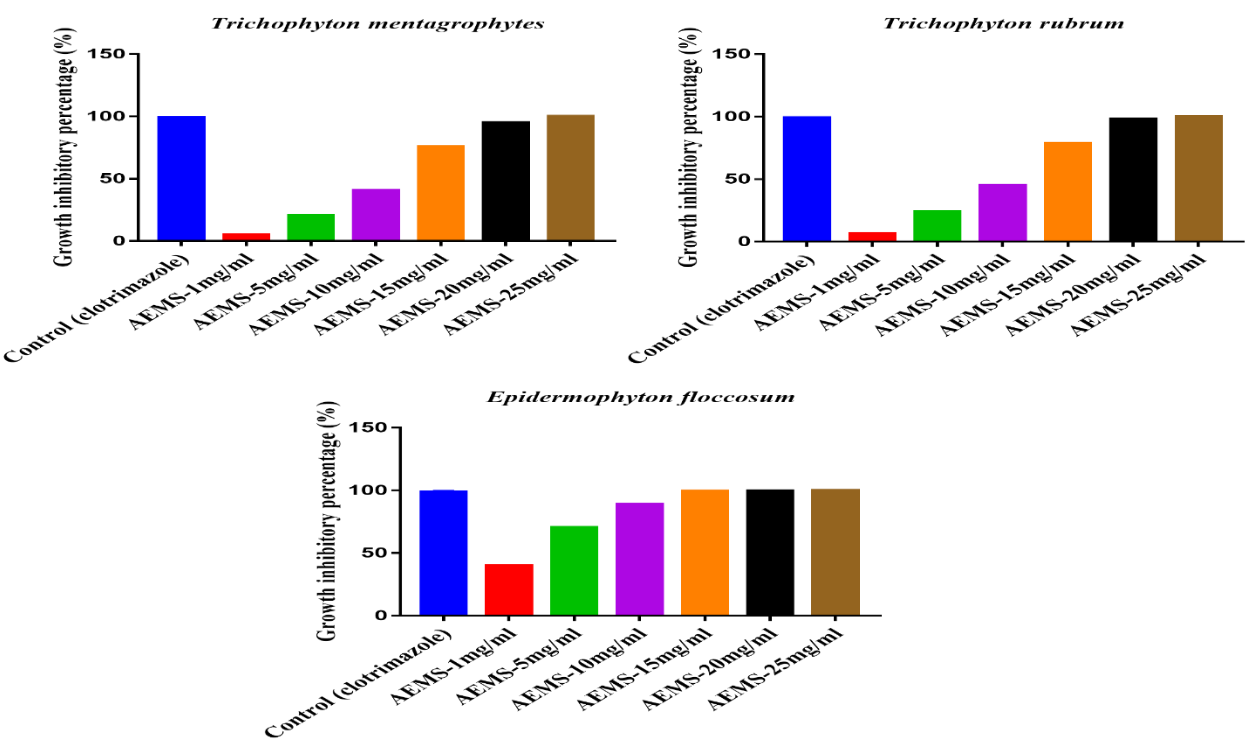

Figure 1: Growth inhibitory effects of aqueous-extract of *Malva sylvestris* (AEMS) against

Discussion

The present study found that there were increases in the inhibition rates against the growth of *T. mentagrophytes*, *T. rubrum*, and *E. floccosum*. The present results came in agreements with those by Shamim and his group (17), in their study, which included the use of ethanolic alcohol and distilled water in the extraction of aloe, allium, and solanum, and the study of the inhibitory effect of these extracts on the growth of a number of pathogenic fungi, which showed that the aqueous extract was highly effective in the inhibitory activity against the growth of their tested microorganisms. The current results also came in agreement with the results of the study conducted by Al-Quraishy and Al-Dhwahery (18), which included the preparation of alcoholic, acetone, and aqueous extracts of six local medicinal plants and studying their inhibitory effect on the growth of a number of pathogenic fungi. The author found that there was superiority of the alcoholic extract over the acetone and aqueous extracts for all plants in decreasing the growth of the examined fungi. Yadav (19) found that the *M. sylvestris* leaf extract was effective in inhibiting the growth of *Alternaria* fungus pathogenic species.

Among the medicinal herbs identified as common mallow in Europe, Iran, Pakistan, and India is *M. sylvestris*. The M. sylvestris is widespread all across the Mediterranean region, including North Africa, Europe, and Southwest Asia. The plant prefers wet conditions and may be found in places like swamps, canals, ocean, and river sides. The ancient Romans and Greeks used this plant for its softening effects. These herbs have been used medicinally for thousands of years to treat a wide range of illnesses, including but not limited to the common cold, burns, coughs, tonsillitis, bronchitis, digestive issues, eczema, and cut wounds. Leaves and flowers from the M. sylvestris plant have been used medicinally for centuries (20,21).

Inflammatory illnesses of the mucous membranes, cystitis, and diarrhea are all treated using aqueous solutions of *M. sylvestris* leaves and flowers. The plant's ability to restore damaged areas comes from the mucilage and flavonoids found in the stems and leaves. One of humanity's first forms of healthcare was the use of plants as cures. In the past 30 years, researchers and doctors have paid more attention to the potential of medicinal herbs for both illness prevention and treatment. The Malvaceae family stands out among the many species employed in traditional medicine owing to the variety of their uses; they have been consumed for at least the last three thousand years (16).

Conclusion

The study findings indicate important effects of *Malva sylvestris* aqueous-extract against the growth of skin and nail fungi of humans.

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