Influence of Aquatic Extracts and Essential Oils Obtained from Some Plants to the Growth of Toxigenic Fungi

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Were investigated aquatic extracts and essential oils obtained from some plants (Agropyrum repens L, Apium graveolens L., Artemisia absinthium L., Mentha piperita L.) included in the flora of Azerbaijan on the growth of toxigenic fungi. It was determined that both materials obtained from the studied plants affects on the growth of toxigenic fungi. Although the effects of aqueous extract are fungistatic, the effects of essential oils are characterized as fungicidal activity. In the case of adding 0.01% of essential oil obtained from the Mentha piperita L. to the medium, the growth of all toxigenic fungi stops. This allowed us to note that the use of preparation obtained from same plant against of toxigenic fungi in the future is respectively.

Keywords: Essential Oils; Fungistatic; Fungicidal Effects; Plant extracts.

Despite significant advances in the development of a new generation synthetic medicinal drugs in recent years there has been an increasingly growing interest in drugs derived from natural sources, especially from plants[1]. The importance and relevance of creation of the medicinal drugs on the basis of vegetable raw materials can be explained by the presence of a wide spectrum of pharmacological action, soft and harmonious effect on all systems of the body with minimum side effects under conditions of a long-term administration. In this matter, medicinal plants are of special interest; some of these plants are essential-oil plants amounting to about 2500 species, and in particular cells of essential oils contain the volatile compounds which are practically water-insoluble. They are like complex mixtures of different organic compounds, terpenes, alcohols, aldehydes, ketones, being the main source of pharmacologically active substances[2].

It should be noted that the essential oils of various plants have been using for medicinal

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purposes all over the world since ancient ages, especially in folk medicine as an analgesic, sedative, anti-inflammatory, hemostatic, liquefacient, immune-enhancing drug. Moreover, they have antioxidant, antiviral, antibacterial and fungicidal activities[3-4], making them useful agents for diseases control caused by viruses, bacteria and fungi.

It should also be noted that there are about 4700 species of plants, 1/3 of which are considered medicinal ones in the flora of Azerbaijan. The flora of Azerbaijan is rich in essential oils, there are about 800 species, and they are widespread throughout the territory of Azerbaijan[5]. Many essential-oil plants included both in the world's flora and flora of Azerbaijan, have not been studied as a source of substances having the activity of fungicidal character.

Based on the above, this work is dedicated to the study of fungicidal properties of some essential-oil plants, spread in various territories of Azerbaijan. Selection of the test object of the fungi is related to the fact that some microscopic fungi are the cause of a number of diseases both in humans and in plants and animals[6-7]. Moreover, many fungi are toxigenic and enrich the habitat with toxic substances. The result is also hazardous to the health of all living beings, especially for human keeping in contact with the same situations. In addition, the global environmental problems have led to an increase the fungal diseases, it also increased the likelihood of pandemics[8]. All this also makes necessary task to study the possibility of obtaining environmentally clear and sustainable preparation that partially or completely limit the activity of fungi.

MATERIALS AND METHODS

In the course of study were used following plants included in the flora Azerb aijan[9-10]:

1. Agropyrum repens L. - is a perennial herb. It is spread in almost all regions of Azerbaijan, mainly in humid and grassy areas. It contains a small amount of essential oil, mucilage, vanillin, etc. The plant is used in folk medicine as anti-inflammatory, diuretic, and skin diseases.

2. Apium graveolens L. -an annual or biennial herbaceous plant. Flowers are white, gathered in a complex umbrella, fruits are bifid achenes and very small. In Azerbaijan grows about all regions. The leaves of celery contain glycoside apiin, essential oil, albumen, carotene. The fruits contain essential oil to 3%, in addition, fatty oil and common ash.

3. Artemisia absinthium L. - It is a perennial herb. This plant has spread to many areas of Azerbaijan. Mainly used the above-ground parts and leaves of the plant. Plant contains 0.25-1.32% essential oil which is dominated by thulyl alcohol, pinene, chamazulene, etc. It should also added that the plant is used in folk medicine for gastrointestinal, anemia, and lung diseases.

4. Mentha piperita L. - is a perennial herb with a creeping stem. It can be said that the plant has spread in almost all regions of Azerbaijan. The plant contains about 3.5% EY, of which up to 80% is mehtol. The plant is widely used in folk medicine and as food.

Samples were taken mainly from the surface area of plants, namely from the trunk, leaves and flowers, dried in air (22-35^{0}C) and used according to the work. During sampling was mainly preferred to areas where the plant is more prevalent and its reserves are relatively large

The following fungi were used as a test culture:

1. Aspergillus flavus Link
2. A.ochraeus K. Wilh
3. Cladosporium herbarium (Pers.) Link
4. Fusarium moniliforma J. Sheld.
5. F.oxysporum Schecht
6. Penicillium citrinum Thom
7. P.cuclopium Westling

In previous studies, these mentioned cultures were isolated from soil and plant samples taken from different areas of Azerbaijan and has been assessed by their toxic (phyto- and zoo-toxic) activity in laboratory conditions. As a test culture, those fungi were used that showed medium and strong toxic activity[11].

To test the effect of the studied plants on the growth of toxigenic fungi were used aqueous extract and essential oil of these plants.

To obtain an aqueous extract, the plants were extracted with tap water in a ratio of 1:10 (i.e., 1 g of air-dry plant mass was added to 10 ml of water) in a water bath at a temperature of 65^{0}C for 20-30 minutes. The obtained water extract was sieved after cooling, diluted (10-100 fold) and added into in the amount of 100 ml to each 200 ml flask, pH was adjusted to 6.5-7.0, then sterilized

for 45 minutes at 0.5 atm. Further fungal cultures were cropped in flasks with water extracts of plant species being studied. Czapek's medium was taken as a control. Cultivation was performed in an oven at a temperature of 26-28^0 Ñ for 7 days. The biomass was determined after filtration, leading to a constant weight of 0 (at 105^{0}Ñ), by drying after every 24 hours of culture growth.

To study the fungicidal properties of the following essential oils were used *A. graveolens*, *A. absinthium* and *M. piperita*, which were received by a group of the Institute of Petrochemical Processes of the Ministry of Science and Education of the Republic of Azerbaijan. The method of hydrodistillation have been as used to obtain essential oil (EO)[12]. The resulting oil was added to the liquid Czapek's medium so that the amount of oil in the medium is within the range of 0.001-0.01%. After the abovementioned mushrooms medium inoculation, flasks were placed in an incubator with the above conditions (26-28^{0}Ñ, for 7 days).

After the expiration of the term of cultivation, the biomass was filtered, weighed, bringing to a constant weight.

RESULTS

The results obtained during the study of the effect of water extracts and essential oil obtained from the studied plants on the growth of toxigenic fungi used as test cultures are given in Tables 1 and 2.

Table 1. Influence of water extracts of plants on the growth of fungi

Fungi	Ratio aqueous extracts : water	*Agropyrum repens* L.	*Apiumgra veolens* L.	*Artemisia absinthium* L.	*Mentha piperita* L
		Yield of biomass (g/l)			
Aspergillus flavus	1:10	1.12	0.71	0.52	0.63
	1:50	2.07	1.63	1.17	1.32
	1:100	3.96	3.4	2.92	2.98
	control	5.23			
A.ochraeus	1:10	1.23	0.78	0.57	0.64
	1:50	2.36	2.32	1.72	2.12
	1:100	4.01	3.80	3.14	3.61
	control	5.62			
Cladosporiumherbarium	1:10	0.75	0.59	0.43	0.52
	1:50	2.97	2.15	2.06	2.08
	1:100	3.60	3.06	3.01	3.11
	control	3.71			
Fusariummoniliforma	1:10	0,64	0.42	0.29	0.32
	1:50	2.04	1.71	1.47	1.51
	1:100	3.60	3.41	3.02	3.31
	control	3.74			
F. oxysporum	1:10	0.42	0.29	0.20	0.23
	1:50	2.03	1.61	1.01	1.42
	1:100	a3.76	3.71	3.13	3.52
	control	3.96			
Penicilliumcitrinum	1:10	0.41	0.18	0.14	0.17
	1:50	2.05	1.54	1.32	1.43
	1:100	3.70	2.27	2.21	2.42
	control	3.82			
P. cuclopium	1:10	0.76	0.47	0.34	0.45
	1:50	2.08	1.63	1.13	1.60
	1:100	3.98	3.03	2.73	2.83
	Control	4.12			

From the obtained results became clear that in the composition of both aqueous extract and the essential oils obtained from the investigated essential oil plants mets components which weakens, even stops the growth of toxigenic fungi in a certain proportion. In the formation of observed effect participates both tested plants and used test cultures. For example, when using water extracts in the highest density (ratio 1/10), a weakening of growth is mainly observed, the maximum value of which, depending on plants and fungi, ranges from 78.1-96.3%. In this case, the highest effect observed between plant *Artemisia absinthium* and fungi *Pencillium citrinum*, and the lowest effect observed between plant *Apium graveolens* and fungi *Cladosporium herbarium*. The antifungal effect of *Agropyrum repens* L is weaker than other plants. The issue with the essential oils plants is somewhat different. The EO obtained from the *M.piperita* plant exhibits fungicidal activity at the highest concentration (0.1%), stopping all growth of test cultures. The EO obtained from the *A.absinthium* plant has a similar effect on the used fungi except on *A. flavus*. Although a significant weakening of growth is observed in all fungi, some even have a complete cessation of growth. In other word, the plants studied have a promising perspective in terms of obtaining preparation against of toxigenic fungi.

Discussion of results

Quantitative and qualitative differences of the different components (extracted from water, alcohol, etc.) in the plants are reflected in the work done by various researchers. So that, they differ

Table 2. Effect of essential oil of the plants used on the growth of fungi

Fungi	Number of EM in the medium (%)	*Agropyrum repens* L.	*Apiumgra veolens* L	*Artemisia absinthium* L.	*Mentha piperita* L
		Yield of biomass (g/l)			
Aspergillus flavus	0.01	0.21	0.01	0.11	0.00
	0.005	0.87	0.25	0.63	0.21
	0.001	2.10	1.42	1.02	2.98
	control	5.23			
A.ochraeus	0.01	0.00	0.00	0.00	0.00
	0.005	0.24	0.12	0.04	0.06
	0.001	0.52	0.34	0.17	0.21
	control	5.62			
Cladosporiumherbarium	0.01	0.01	0.00	0.00	0.00
	0.005	0.29	0.15	0.00	0.08
	0.001	0.87	0,65	0.12	0.53
	control	3.71			
Fusariummoniliforma	0.01	0.02	0.01	0.00	0.00
	0.005	0.25	0.15	0.07	0.11
	0.001	0.57	0.41	0.28	0.32
	control	3.74			
F.oxysporum	0.01	0.03	0.01	0.00	0.00
	0.005	0.24	0.11	0.08	0.12
	0.001	0.74	0.31	0.38	0.52
	control	3.96			
Penicilliumcitrinum	0.01	0.00	0.00	0.00	0.00
	0.005	0.12	0.05	0.02	0.08
	0.001	0.54	0.21	0.18	0.32
	control	3.82			
P.cuclopium	0.01	0.01	0.00	0.00	0.00
	0.005	0.14	0.02	0.00	0.03
	0.001	0.20	0.11	0.08	0.12
	control	4.12			

by composition of the component as well as the number of major and minor components[7]. Despite the differences, plants are currently attracting attention as the source of these substances. In particular, a number of synthetic fungicides have become resistant to phytopathogens as they cause serious damage to plants, and in this respect the attention to them has increased. From the work of Saharkhiz M.J. and others[13] became clear that essential oil obtained from *Mentha piperita* plant has broad antifungal activity therefore, it can be used in medical prophylaxis and to extend the shelf life of nutrients. Although essential oils obtained from some plants (*Artemisia campestris*)[14], have weak fungicidal effects on fungi such as *Penicillium citrinum, P. viridicatum* and *Aspergillus niger*.

In studies also show that essential oils obtained from *Glycyrrhiza glabra* L., *Matricaria chamomilla* L. and other plants have antifungal activity[15-18]. Were also identified the effective use of them in the areas as animal husbandry, folk medicine, cosmetic making, and other saspect, also to be promising as a substitute for those currently used in other side.

According to the results of our studies, as well as of other studies should be noted that the natural climate and soil conditions of the areas where spread plants from which obtains essential oils influence to the quantitative and qualitative indicators of the components they contain and this case also gives up in their antifungal activity. For example, the same plant grows in different regions of the world. For this reason, it is possible that the water extract or essential oil derived from plants distributed in a particular region may have a more effective effect this is also confirmed by the results of our research.

Conflict of Interest

The authors declare that there is no conflict of interest regarding this paper.

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