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Biological Activities of Medlar (*Mespilus germanica*) Extracts Obtained Using Different Solvents

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Abstract: In this study, antibacterial and antifungal properties of four medlar extracts obtained using four different solvents, ethanol, methanol, acetone and water, were investigated. The disk diffusion method was used to determine the antimicrobial effects of the extracts. In addition, minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC) and minimum fungicidal concentration (MFC) values were determined. The antibacterial effect of the pure water extract of medlar on *S. aureus* bacteria was found to be high (11.46 mm). In addition, the MIC and MBC values of the pure water extract were determined as 35.15 and 23.39 µg/mL for *S. aureus* bacteria. When the antifungal effect was examined, the antifungal effect of the pure water extract of medlar against *P. crysogenum* was found to be high (14.00 mm). The MIC and MFC values of the pure water extract of medlar are 23.43 and 11.72 µg/mL for *P. crysogenum*, respectively. Therefore, it was concluded that the pure water extract had the highest antimicrobial effect.

Keywords: Medlar extract; antifungal; bactericidal.

1. Introduction

Medlar (*Mespilus germanica* L.) is a perennial plant that grows in a tree or shrub belonging to the Rosaceae family [1]. While they are around 2-3 m in the natural environment, they can reach 4-6 m when cultured [2]. While medlar mainly grows in its forest or mountainous areas, in some regions it is cultured due to its economic value. It is also cultured as ornamental in parks and gardens [1]. Therefore, it spreads in a wide geography from Asia to Europe. The fruits are harvested in autumn, especially in October and November. It is kept in a cool and dark environment before being put on the market for a few weeks. In this process, the fruit matures depending on enzymatic activities, gaining its unique taste, texture, and colour properties [3].

Medlar fruit has been consumed in different ways by human beings since ancient times. As the fruit can be consumed fresh, it can also be consumed in various formulations such as pickles, jam, jelly, marmalade, syrup, wine and sauce [4]. In addition, medlar fruit is a rich source of sugar, phenolic compounds, organic acids, vitamin C and mineral substances, especially potassium [5].

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Since medlar has a rich composition in terms of nutrients, it has many positive contributions to human health [6]. This product, which has high antioxidant properties, can reduce the risk of cardiovascular diseases and some types of cancer, has been stated. In addition, its other medicinal benefits include so many positive effects such as removal of abscesses in the mouth, relief of sore throat, elimination of stomach bloating, removal of kidney and bladder stones, diuretic effect, treatment of diarrhoea, treatment of constipation, control of obesity, reduction of fever, regulation of blood values and regeneration of the skin [3;7]

The contribution of the bioactive components of the medlar to its positive effects is quite high. Therefore, the studies carried out so far have focused on the chemical composition of the medlar. On the other hand, studies on the antimicrobial properties of the fruit are very limited [8-9]. For this reason, in this study, the antibacterial and antifungal effects of the extracts of medlar obtained by using different solvents were tried to be determined.

2. Materials and Methods

2.1. Plant Material

Medlar fruit was obtained by handpicking from the rural areas of Erkmen-Afyonkarahisar, Turkey (38°45'22''N, 30°28'49''E, Altitude: 1111) in November 2021.

2.2. Solvent Extraction

400 mL of ethanol (96 %), methanol, acetone and distilled water were added separately to each 250 g shredded medlar sample. Then the samples were shaken at 120 rpm for 24 hours in the dark. The obtained mixtures were filtered through sterilised 22 mm filter paper and transferred to a rotary evaporator (Heidolph Hei-VAP value), at 100 rpm, at a temperature of 60°C for ethanol, methanol and acetone extracts, and a temperature of 90°C for distilled water extracts [10].

2.3. Determination of Antimicrobial Properties of Medlar Extracts

2.3.1. Bacteria Used in The Research

In the research; *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 6538), *Listeria monocytogenes* (ATCC 51774), *S. enterica* ser. Typhimurium (ATCC 14028), *Bacillus cereus* (ATCC 14579) and *Shigella dysenteria* (ATCC 12022) bacteria were used.

2.3.2. Determination of Antimicrobial Effects of Medlar Extracts

The disk diffusion method was used to determine the antimicrobial activities of Medlar fruit extracts in different solvents (Bauer *et al.*, 1959; Bauer *et al.*, 1966). In addition, minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values were determined.

2.3.3. Preparation of Extract Containing Discs

10µl of the extracts were taken into sterile Petri dishes, and empty antibiotic discs (Bio-Disk 316010001) were placed on them. For the discs to absorb extracts, Petri dishes were kept in the refrigerator (4°C) for 1 hour with their lids closed.

2.3.4. Preparation of Inoculums

Bacteria to be used in the research were grown on a non-selective medium, taken from single fallen colonies with the help of a sterile loop, and suspended in physiological saline. The density of the suspension was set to the 0.5 McFarland standard. Density control was controlled by the McFarland turbidity standard [11-12].

2.3.5. Application of Disk Diffusion Method

Microorganisms prepared according to 0.5 McFarland turbidity standard were transferred to Muller Hinton Agar (Merck, Germany, 1.05437) (MHA) by taking 0.1 mL (10^6-10^7 cfu/mL) with a sterile pipette. After waiting 10 minutes for the medium to absorb inoculum sufficiently, extract-impregnated discs were placed on the surface of the medium at such a distance that the zones to be formed would not touch each other.

Escherichia coli, Staphylococcus aureus, Listeria monocytogenes, S. enterica ser. Typhimurium were incubated for 16-20 hours at 37°C (EUCAST, 2018). After incubation, the zones formed around the discs were measured with a digital calliper in an environment with sufficient light [10].

2.3.6. Determining The Minimum Inhibitory Concentration (MIC) Value

Minimum inhibitory concentrations (MIC) of Medlar extracts were determined according to the macrodilution method defined by the "Clinical and Laboratory Standards Institute" [13]. Then, 1 µl (10^6-10^7 cfu/mL) of bacterial cultures in 0.5 turbite inoculated in Nutrient Broth was added to all tubes, including the control tube. The tubes were left to incubate for 16-24 hours at 30°C and 37°C according to the growth characteristics of the bacterial strains. At the end of incubation, the tubes with turbidity, membrane on surface and sediment formation at the bottom were evaluated as growth (+).

In addition, at the end of the incubation, development was observed in the "+ control" tube [10; 14-16].

2.3.7. Determination of Minimum Bactericidal Concentration (MBC) Value

The MBC test, which is defined as the minimum bactericidal concentration (mg/L or µg/mL) necessary to kill most (99.9%) living organisms after incubation for a fixed period (24 hours) under certain conditions, is performed as a continuation of the MIC test.

To determine this value, samples were taken using a sterile loop from all concentrations below the concentration value where the first turbidity was observed on the surface and/or at the bottom and inoculated into Mueller-Hinton Agar (Merch, Germany, 110293). The inoculated medium was incubated for 16-24 hours according to the growth conditions (at 30°C and 37°C) suitable for the bacterial species. The first concentration observed no growth was determined as the MBC value [15].

2.4. Mold species Used in the Study

The mold species used in the study were *Aspergillus flavus* (ATCC 204304), *A. niger* (ATCC 16888), *Penicillium crysogenum* (ATCC 10106), *P. notatum* (ATCC 9478), *Mucor racemosus* (ATCC 42647) and *Rhizopus nigricans* (ATCC 6227b), respectively.

2.4.1. Determination of EO Antifungal Activity by the Disc Diffusion Method

For this purpose, the molds were first adjusted according to the 0.5 McFarland turbidity standard, and 0.1 mL was taken for each mold species using a sterile pipette and inoculation was performed (10^6 – 10^7 cfu/mL). It was waited for 10 minutes for the medium to absorb the inoculum. Then blank antibiogram test discs (6 mm, Bioanalyse) soaked with 15 µL of medlar extract were placed in such a way as to allow the formation of zones on the surface of the medium and at a distance where the zones to be formed would not reach each other. Then, the medium was placed into the incubator (Incucell,

MMM, Germany) and incubated at 25 ± 0.1°C for 72-96 hours. At the end of the incubation period, the diameter of the zones formed around the discs was measured in mm using a digital calliper (Mitutoyo, Ip-67 0-150, Japan) in the presence of sufficient light [17].

2.4.2. Determination of the Minimum Inhibitory Concentration (MIC) and the Minimum Fungicidal Concentration (MFC)

The minimum fungicidal concentrations (MFC), minimum inhibitory concentration (MIC) of medlar extracts were modified from the macrodilution method defined by the "Clinical and Laboratory Standards Institute" (CLSI, 2009).

To determine the MFC values, 1 µl of the first tube, in which a mold growth was observed in the MIC analysis, was taken, serial dilutions of all tubes were prepared with a sterile-tipped automatic pipette. Later samples were inoculated on the surface of Petri dishes containing Sabouraud 2 % Dextrose Agar and the Petri dishes were incubated for 5-7 days at 25ºC under aerobic conditions at appropriate temperatures. After the incubation, the lowest concentration value with no growth was detected in Petri dishes and determined as MFC [17].

3. Results and Discussion

The results obtained by the disk diffusion method regarding the antibacterial effects of *Mespilus germanica* extracts prepared in different solvents are given in Table 1. The antibacterial effects of *M. germanica* extract on food pathogens are given in Table 2. Finally, correlation and variation results of MIC and MBC results of extracts are given in Table 3, MIC values in Table 4, and MBC values in Table 5.

Table 1. Antibacterial activity of *Mespilus germanica* extracts in different solvents on some foodborne pathogens (zone diameter, mm)

Bacteria	Extracts			
	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Escherichia coli	9.11 ± 0.35^{Ab}	7.79 ± 0.07^{Bcd}	7.61 ± 0.45^{Bcd}	9.73 ± 0.27^{Abc}
Staphylococcus aureus	10.21 ± 0.23^{Bab}	9.69 ± 0.15^{Ba}	8.47 ± 0.14^{Cbc}	11.46 ± 0.43^{Aa}
S. enterica ser. Typhimurium	9.34 ± 0.15^{ABab}	8.33 ± 0.21^{Cbc}	8.78 ± 0.60^{BCab}	9.90 ± 0.04^{Abc}
Listeria monocytogenes	10.26 ± 0.55^{ABa}	8.83 ± 0.50^{Bb}	9.78 ± 0.58^{ABa}	10.79 ± 0.46^{Aab}
Bacillus cereus	9.94 ± 0.24^{ABab}	8.80 ± 0.34^{Bb}	9.18 ± 0.51^{Bab}	11.10 ± 0.78^{aa}
Shigella dysenteria	9.39 ± 0.03^{Aab}	7.60 ± 0.08^{Bd}	7.01 ± 0.35^{Cd}	9.53 ± 0.36^{Ac}

a - d (↓): Values with the same capital letters in the same column for each analysis differ significantly ($p< 0.05$), A - C (→): Values with the same capital letters in the same line for each analysis differ significantly ($p< 0.05$).

Table 2. Antibacterial effect of *Mespilus germanica* extracts in different solvents on some foodborne pathogens

Bacteria	Extracts			
	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Escherichia coli	++	-	-	++
Staphylococcus aureus	++	++	+	+++
S.enterica ser. Typhimurium	++	+	+	++
Listeria monocytogenes	++	+	++	++
Bacillus cereus	++	+	++	+++
Shigella dysenteria	++	-	-	++

6-8(-): Resistance, 8-9(+): Intermediate Sensitive, 9-11(++): Sensitive, 11≥ (+++): Multi sensitive.

Table 3. Correlation and variations of antibacterial activity, MIC and MBC analysis

Interaction	Data					
	Antibacterial Activity		MIC		MBC	
	p-Value	*r*	*p*-Value	*r*	*p*-Value	*r*
Extract (E)	< 0.0001	0.207	< 0.0001	-0.101	< 0.0001	-0.081
Bacteria Species (B)	< 0.0001	-0.029	< 0.0001	-0.155	< 0.0001	-0.131
E x B	0.039	--	0.001	--	0.010	--

r: correlation coefficient, p <0.0001: Statistically too much significant, p <0.01: Statistically too significant, p <0.05: Statistically significant, p >0.05: Not statistically significant, *ns*: Not statistically significant, **p* <0.05; ***p* <0.01.

Table 4. MIC (µg/mL) value for foodborne bacteria as effected by *Mespilus germanica* extracts in different solvents

Bacteria	Extract			
	Ethanol	Methanol	Acetone	Pure Water
Escherichia coli	281.2 ± 93.75^{Ba}	750.0 ± 0.00^{Aa}	750.0 ± 0.00^{Aa}	140.6 ± 46.87^{Ba}
Staphylococcus aureus	140.6 ± 46.87^{ABa}	281.2 ± 93.75^{ABbc}	562.5 ± 187.5^{Aab}	35.15 ± 11.72^{Bb}
S. enterica ser. Typhimurium	187.5 ± 0.00^{ABa}	562.5 ± 187.5^{Aab}	375.0 ± 0.00^{ABbc}	93.75 ± 0.00^{Bab}
Listeria monocytogenes	93.75 ± 0.00^{BCa}	375.0 ± 0.00^{Abc}	281.2 ± 93.75^{ABbc}	70.31 ± 23.43^{Cab}
Bacillus cereus	281.2 ± 93.75^{Aa}	187.5 ± 0.00^{ABc}	187.5 ± 0.00^{ABc}	46.88 ± 0.00^{Bb}
Shigella dysenteria	187.5 ± 0.00^{Ba}	750.0 ± 0.00^{Aa}	750.0 ± 0.00^{Aa}	93.75 ± 0.00^{Bab}

a - c (↓): Values with the same capital letters in the same column for each analysis differ significantly (p< 0.05). A - C (→): Values with the same capital letters in the same line for each analysis differ significantly (p< 0.05).

Table 5. MBC (µg/mL) value for foodborne bacteria as effected by *Mespilus germanica* extracts in different solvents

Bacteria	Extract			
	Ethanol	Methanol	Acetone	Pure Water
Escherichia coli	375.0 ± 125.0^{BCa}	750.0 ± 250.0^{ABab}	1000 ± 0.00^{Aa}	93.75 ± 31.25^{Cab}
Staphylococcus aureus	46.88 ± 15.62^{Ab}	187.5 ± 62.5^{Ac}	312.5 ± 187.5^{Ab}	23.39 ± 7.86^{Ac}
S. enterica ser. Typhimurium	187.5 ± 62.5^{Aab}	375.0 ± 125.0^{Abc}	375.0 ± 125.0^{Aab}	93.75 ± 31.25^{Aab}
Listeria monocytogenes	62.50 ± 0.00^{Bb}	500.0 ± 0.00^{Abc}	187.5 ± 62.5^{Bb}	62.50 ± 0.00^{Babc}
Bacillus cereus	250.0 ± 0.00^{Aab}	187.5 ± 62.5^{Ac}	125.0 ± 0.00^{ABb}	31.25 ± 0.00^{Bbc}
Shigella dysenteria	93.75 ± 31.25^{Bb}	1000 ± 0.00^{Aa}	625.0 ± 375.0^{ABab}	125.0 ± 0.00^{Ba}

a - c (↓): Values with the same capital letters in the same column for each analysis differ significantly (p< 0.05). A - C (→): Values with the same capital letters in the same line for each analysis differ significantly (p< 0.05).

When the antibacterial activity of *M. germanica* was examined, the highest antibacterial effect was determined in the pure water extract against *S. aureus* with a zone diameter of 11.46 mm (p<0.05). On the other hand, the lowest antibacterial activity was detected in acetone extract against *S. dysenteria* bacteria with a zone diameter of 7.01 (p<0.05). In general, the antimicrobial activity of the extracts obtained with pure water was high. The antibacterial effect of acetone extracts was weak.

When the results of the susceptibility of the bacteria to the medlar extracts obtained in different solvents (Table 2) were examined, it was determined that *S. aureus* and *B. cereus* bacteria were sensitive to the pure water extract.

According to the analysis of variance, the effects of the extract on bacteria and extract X bacteria interactions were found to be significant at the p<0.0001 level (Table 3).

MIC and MBC results of medlar extracts are given in table 4 and table 5. MIC values ranged from 35.15 to 750 µg/mL. It was determined that low concentrations of pure water extract would be sufficient to inhibit *S. aureus* and *B. cereus* bacteria. On the other hand, it was concluded that high concentrations of methanol and acetone extracts are required to inhibit *E. coli* and *S. dysenteria* bacteria. MBC values of medlar extracts were determined as 1000 µg/mL in acetone extract for *E. coli* bacteria and 23.39 µg/mL in pure water extract for *S. aureus* bacteria.

Table 6. Antifungal activity of *Mespilus germanica* extracts in different solvents on some foodborne molds (zone diameter. mm)

Fungus	Extracts			
	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Aspergillus flavus	13.81 ± 0.53^{Aa}	10.52 ± 0.41^{BCa}	9.72 ± 0.42^{Ca}	11.64 ± 0.18^{Bbc}
Aspergillus niger	12.00 ± 0.08^{Ab}	8.15 ± 0.03^{Bb}	6.69 ± 0.04^{Ccd}	12.08 ± 0.46^{Ab}
Penicillium notatum	12.18 ± 0.10^{Ab}	8.74 ± 0.21^{Bb}	8.23 ± 0.13^{Bb}	12.30 ± 0.34^{Ab}
Penicillium crysogenum	11.71 ± 0.13^{Bb}	9.67 ± 0.40^{Ca}	8.79 ± 0.27^{Cb}	14.00 ± 0.10^{Aa}
Mucor racemosus	10.46 ± 0.11^{Bc}	7.95 ± 0.12^{Cb}	7.05 ± 0.06^{Dc}	11.04 ± 0.15^{Acd}
Rhizopus nigricans	9.96 ± 0.29^{Ac}	6.40 ± 0.22^{Bc}	6.18 ± 0.16^{Bd}	10.19 ± 0.08^{Ad}

a - d (↓): Values with the same capital letters in the same column for each analysis differ significantly ($p< 0.05$). A - D (→): Values with the same capital letters in the same line for each analysis differ significantly ($p< 0.05$).

It was observed that low concentrations would be sufficient for the pure water extract of medlar to be effective on *S. aureus*. MIC and MBC values were 35.5 and 23.39 µg/mL, respectively.

A study examining the antibacterial properties of the methanol extract of the medlar leaf reported that it had antibacterial activity against both Gram-positive and Gram-negative bacteria, and a higher inhibition zone (30.83 mm) was detected against *S. aureus* [18].

In a similar study, the antibacterial effect of the extract of the mixture of hawthorn and medlar obtained in pure water and 50% ethanol was investigated. It was determined that it had a strong antimicrobial effect on *Klebsiella pneumonia*. [8].

In a different study, the antibacterial effect of medlar extract was investigated. It was determined to be effective on *Streptococcus pyogenes* and *Listeria innocua* [9].

Table 7. Antifungal effect of *Mespilus germanica* extracts in different solvents on some foodborne molds

Fungus	Extracts			
	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Aspergillus flavus	+++	++	++	+++
Aspergillus niger	+++	+	-	+++
Penicillium notatum	+++	+	+	+++
Penicillium crysogenum	+++	-	+	+++
Mucor racemosus	++	-	-	+++
Rhizopus nigricans	++	-	-	++

6-8(-): Resistance. 8-9(+): Intermediate Sensitive. 9-11(++): Sensitive. 11≥ (+++): Multi sensitive.

Table 8. Correlation and variations of antifungal activity. MIC and MFC analysis

Interaction	Mold					
	Antifungal Activity		**MIC**		**MFC**	
	***p*-Value**	***r***	***p*-Value**	***r***	***p*-Value**	***r***
Extract (E)	< 0.0001	-0.011	< 0.0001	0.016	< 0.0001	-0.061
Mold Species (M)	< 0.0001	-0.380**	0.01	0.167	< 0.0001	0.243
E x M	< 0.0001	--	0.09	--	< 0.0001	--

r: correlation coefficient. p <0.0001: Statistically too much significant. p <0.01: Statistically too significant. p <0.05: Statistically significant. p >0.05: Not statistically significant. ns: Not statistically significant. *p <0.05; **P <0.01.

The results regarding the antifungal activities of medlar extracts obtained from different solvents are given in Table 6. The highest antifungal effect was found on *P. crysogenum* in pure water extract with a zone diameter of 14.00± mm. It was determined that the mold species used in the study were susceptible to ethanol and water extracts (Table 7).

According to the analysis of variance, the effects of extract, mold and extract x mold interactions were found to be significant at the p<0.0001 level (Table 8).

Table 9. MIC (µg/mL) value for foodborne molds as effected by *Mespilus germanica* extracts in different solvents

Fungus	Extracts			
	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Aspergillus flavus	70.31 ± 23.44^{Bb}	281.25 ± 93.75^{Ac}	562.50 ± 187.5^{Ab}	98.13 ± 892.37^{Ba}
Aspergillus niger	281.25 ± 93.75^{BCab}	562.50 ± 187.5^{Bbc}	1500.00 ± 0.00^{Aa}	58.59 ± 35.16^{Ca}
Penicillium notatum	93.75 ± 0.00^{BCb}	750.00 ± 0.00^{Ab}	140.63 ± 46.85^{Bb}	29.29 ± 17.58^{Ca}
Penicillium crysogenum	117.19 ± 70.3^{ABb}	281.25 ± 93.75^{Ac}	93.75 ± 0.00^{ABb}	23.43 ± 0.00^{Ba}
Mucor racemosus	234.38 ± 140.62^{Aab}	750.00 ± 0.00^{Ab}	937.50 ± 562.5^{Aab}	70.31 ± 23.44^{Aa}
Rhizopus nigricans	562.50 ± 187.5^{Ba}	1500.00 ± 0.00^{Aa}	1500.00 ± 0.00^{Aa}	140.63 ± 46.87^{Ca}

a - d (↓): Values with the same capital letters in the same column for each analysis differ significantly ($p< 0.05$). A - C (→): Values with the same capital letters in the same line for each analysis differ significantly ($p< 0.05$).

When the MIC values of the samples were examined, it was determined that a low concentration (23.43 µg/mL) of pure water extract would be sufficient for the inhibition of *P. crysogenum*. However, when Table 9 was examined, it was determined that methanol and acetone extracts should be used in high concentrations (1500 µg/mL) to inhibit *R. nigricans*.

Table 10. MFC (µg/mL) value for foodborne molds as effected by *Mespilus germanica* extracts in different solvents

	Ethanol	**Methanol**	**Acetone**	**Pure Water**
Aspergillus flavus	46.88 ± 15.62^{Ba}	187.50 ± 62.5^{ABc}	375.0 ± 125.00^{Abcd}	78.13 ± 46.87^{ABa}
Aspergillus niger	93.75 ± 31.25^{Ba}	500.00 ± 0.00^{ABbc}	750.0 ± 250.00^{Aab}	23.44 ± 7.81^{Ba}
Penicillium notatum	46.88 ± 15.62^{Ba}	750.00 ± 250.00^{Aab}	93.75 ± 31.25^{Bcd}	23.44 ± 7.81^{Ba}
Penicillium crysogenum	62.50 ± 0.00^{Ba}	375.00 ± 125.00^{Abc}	46.88 ± 15.62^{Bd}	11.72 ± 3.90^{Ba}
Mucor racemosus	93.75 ± 31.25^{Ba}	375.00 ± 125.00^{Abc}	500.0 ± 0.00^{Abc}	62.50 ± 0.00^{Ba}
Rhizopus nigricans	156.2 ± 93.75^{Ba}	1000.0 ± 0.00^{Aa}	1000 ± 0.00^{Aa}	93.75 ± 31.25^{Ba}

a - d (↓): Values with the same capital letters in the same column for each analysis differ significantly ($p< 0.05$). A - C (→): Values with the same capital letters in the same line for each analysis differ significantly ($p< 0.05$).

When the MFC values given in Table 10 were examined, it was determined as 1000 µg/mL in methanol and acetone extract for *R. nigricans* and 11.72 µg/mL in pure water extract for *P. crysogenum*. Therefore, it was determined that low concentrations would be sufficient for the pure water extract of medlar to be effective on *P. crysogenum*. MIC and MBC values were 23.43 and 11.72 µg/mL, respectively.

According to the research results, the highest antibacterial and antifungal effects were found in the pure water extract of the medlar. The antimicrobial quality of the extracts obtained using different organic solvents was effected.

3. Conclusion

This study showed that extracts of medlar fruit obtained in different solvents have different antibacterial and antifungal properties. According to the study results, it was concluded that the pure water extract of medlar showed a strong antimicrobial effect. There are studies in the literature on the antioxidant properties of extracts of medlar fruit in different solvents. However, considering its antimicrobial properties, there are only a limited number of studies on antibacterial properties. Therefore, it is thought that this study contributes to the literature on the antifungal properties of medlar extracts.

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