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ANTIMICROBIAL EFFECTS OF DIFFERENT SOLVENT EXTRACTED SAMPLES OF LEAVES AND ROOTS OF *VERBASCUM THAPSUS* L. (COMMON MULLEIN)

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ABSTRACT

Antibacterial and antifungal activities of different solvents methanolic extracts of roots and leaves of *Verbascum thapsus* L. were carried out through disc diffusion assay. Five solvents (methanol, n-hexane, n-butanol, ethyl acetate and water) were employed, and five microorganisms (*Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Xanthomonas compestris* and *Candida albicans*) were used. In case of leaf extract maximum zone of inhibition i.e 42.3, 48.3, 41.6, 35.8% was observed using ethyl acetate as solvent in 3mg/disc for *Candida albicans, Pseudomonas aeruginosa, Xanthomonas compestris* and *Bacillus subtilis*, respectively. However in case of *Escherichia coli* maximum zone of inhibition i.e 52.2% was observed using n-hexane as a solvent in 3 mg/disc concentration. In case of root extract, differential values of inhibition zone were observed for each microorganism. For *Candida albicans* maximum zone of inhibition (36.6%) was observed using n-butanol in 3 mg/disc concentration. While for *Pseudomonas aeruginosa, Xanthomonas compestris* and *Bacillus subtilis* ethyl acetate in 3mg/disc proved to be the best solvent showing 59.5% zone of inhibition. *Escherichia coli* showed maximum zone of inhibition (55.4%) when methanol in 3mg/disc concentration was used. Over all, ethyl acetate (3 mg/disc) has proven to be the best solvent used for fractionation in both the leaf and root extract. Root extract in comparison to leaf showed efficient antimicrobial activity.

Key Words: Antimicrobial activity, *V. Thapsus, B. subtilis, E. coli, P. aeruginosa, X. compestris*

INTRODUCTION

Common Mullein also called as Wooly Mullein (*Verbascum thapsus* L., *Scrophulariaceae*), is a vertical biennial plant, a short growing rosette of bluish gray-green color in the first year, while matured second-year flowering plants grow up to 5-10 feet in height, including the conspicuous flowering stalk. It is native to Europe and Asia (Semenza *et al.*, 1978) and was probably introduced to North America many times as a therapeutic herb (Gross and Werner, 1978). Since ancient eras, Common Mullein has been used as a medicinal herb. The leaves and blossoms are described to have demulcent and expectorant properties which are used to treat breathing diseases like tuberculosis, bronchitis, whooping cough, asthma, dry coughs and hoarseness (Grieve, 1971).

The dry leaves are smoked in normal tobacco pipe to get rid of the irritation of the lung mucus membrane. . The leaves are employed with the same benefit when made into cigarettes, for asthma and sporadic coughs (Mabey, 1988). The flowers have been used as benefitting purposes as well by keeping them in a bottle, setting in sunlight are considered for healing hemorrhoids due to the fatty matter produced. Haemorrhoidal complaints were having fomentations and coverings of leaves as major causes (Tyler, 1993). *Verbascum thapsus* is also presumed to be of more assess during diarrhea problems, due to its demulcent and acerbic properties, thus this mixture fortifying the bowels at adequate time (Tyler, 1994). Leaf extracts of common mullein have been demonstrated to move against bovine herpes virus type-1 and showed to have minor antimicrobial activities (McCutcheon *et al.*, 1992, 1994, 1995). This plant also proved to show prohibition against the murine lymphocytic leukemia disease and the (A2, B) influenza viruses as well (Sener and Dulger, 2009).

The present study was aimed to evaluate the antibacterial and antifungal potential of roots and leaves of *Verbascum thapsus* L.

MATERIALS AND METHODS

Plant Material

This research study was performed at Institute of Biotechnology and Genetic Engineering (IBGE), The University of Agriculture, Peshawar. The leaves and roots of the plant *Verbascum thapsus* L. were collected from

different areas of Khyber Pakhtunkhwa, Pakistan. Plant materials were water-washed in order to remove the dust and dirt, followed by drying in shade.

Crude Extracts Preparation

Plant roots and leaves drying dried in shade were grinded until they became powdered using an electric-grinder. After grinding, the plant material was soaked in the methanol solution (analytical grade) for about 7 days in order to separate their constituents. The solution was kept on shaking periodically with the purpose of complete mixing of the bioactive compounds. This process was followed by filtration using Grade 1 (Whatman) filter paper. The processing material was desiccated under minimized pressure which was employed with the help of rotary evaporator. This entire process was repeated thrice in order to get the maximum extract. Some part of the desiccated crude methanolic extract was kept aside to be used as such and the other to be fractioned i.e n-hexane, ethyl acetate, and n-butanol.

Fractionation

The crude methanolic extract of leaves and roots were dissolved in distilled water and was transferred to separating funnel in order to get the extract. The Precise quantity of 300-ml of n-hexane was added, then shaken for some time and then allowing them to stand for about 10 minutes. After the settling down of the solution, the organic layer formed at the top was collected. This whole process was done thrice just replacing organic solvent fresh each time. Further fractionation was performed by adding ethyl acetate, butanol, and water each of them the same way. The organic layers were desiccated with the help of rotary evaporator.

Culturing Media

Culturing media having Nutrient agar as a major source was used to grow several candidate microbes; while the nutrient broth was the part of studies for incubation (shaking) and standardization of different types of microbes (Bakht *et al.*, 2011).

Microbial Activity

The major types of target microbes are from Kingdom Fungi and Eubacteria; therefore antibacterial and antifungal activities of the selected solvent extracts (from leaves and roots) were tested against selected strains of bacteria and fungi.

Antibacterial Bioassay

The antibacterial and antifungal activities were performed using disc diffusion assay according to Bakht *et al.* (2011) against selected strains of bacteria and fungi (Table 1). Microbial inoculums were subjected to the media plates (nutrient agar) for about 18-24 hours. The standard of inoculums used was McFarland Standard i.e. 1-2×107 CFU ml-1 0.5. Three discs of the filter paper of size of about 6 mm diameter were prepared and placed in the Petri dishes having media using sterile forceps. The plant extracts having a concentration of 0.5 and 1-mg were taken in the amounts in 6-µL and 12-µL volumes and used. The positive control antibiotics were used as 6-µL/disc while DMSO was used as a negative control with the same ratio. After inoculation, the plates were incubated at 37ºC for about 24 hours. Within a daytime period, inoculum has inhibited the microbial growth on the plates and was recorded as the zone of inhibition in mili-meter.

The amount and concentration of the bacteria (gram negative and positive) was taken as Ciprofloxacin 50-µg/6µL while Fluconazole was used for the concerned fungal strains as 50µg/6µL. The negative control used was DMSO.

RESULTS

The current research study was performed to investigate the antimicrobial activities of leaves and roots of *Verbascum thapsus*. All the solvent extracted samples were tested against five microbes consisting of four bacterial and one fungal species.

Antimicrobial activities of different solvent extracted samples from the leaves of *Verbascum thapsus*

The antimicrobial effect of ethyl acetate, n-hexane, methanolic, and aqueous (water) extracts from leaves of *Verbascum thapsus* against *Candida albicans* is tabulated in (Table 2). The data describes that *Candida albicans* exhibited susceptible behavior in response to crude (methanol) and ethyl acetate measuring activity of 32.3, 34.3 and 35, 42.3% at concentrations of 2 and 3 mg/disc, respectively. Ethyl acetate fraction showed the highest zone of

inhibition (ZI) (42.3% at 3 mg/disc concentrations). N-hexane fraction showed 32% and 33.6% ZI at 2 and 3 mg/disc concentrations. N-butanol showed also good results. Aqueous extracts showed 35.6% ZI at higher concentration.

Table 1. The microbial strains used are following.

Microbial species/strains	**Strain Type (Gram)**	**Microbial strain sources**
Bacillus subtilis	Positive	Dept. of Microbiology, Quaid-I-Azam University Islamabad, Pakistan
Eschereichia coli	Negative	ATCC # 25922
Pseudomonas aeruginosa	Negative	ATCC # 9721
Xanthomonas compestris	Negative	ATCC # 33913
Candida albican	Fungal	ATCC # 10231. Dept. of Plant Pathology, Uni. of Agric. Peshawar, Pakistan

Table 2. Antifungal effect of different solvents extracted samples from leaves of *Verbascum thapsus* on *Candida albicans* growth.

		Zone of inhibition (ZI) in mm *Candida albicans*			
Plant Extracts	**Concentration of extract mg disc^{-1}**	**Mean ± S.D**	**Zone of inhibition (ZI) (%)**	**Positive control (Ciprofloxacin) (mm)**	**Negative control (DMSO) (mm)**
Crude (Methanol)	**1**	8.3±0.5	27.6	30	-
	2	9.7± 0.4	32.3		-
	3	10.3± 0.5	34.3		-
n-Hexane	**1**	7.6± 0.3	25.3		-
	2	9.6 ±0.3	32		-
	3	10.1± 0.1	33.6		-
n-Butanol	**1**	5.5± 0.5	18.3		-
	2	6.1 ±0.8	20.3		-
	3	9.0± 0.0	30		-
Ethyl acetate	**1**	8.0± 0	26.6		-
	2	10.5± 0.5	35		-
	3	12.7± 0.6	42.3		-
Aqueous	**1**	0.0± 0.0	0		-
	2	9.1± 1.8	30.3		-
	3	10.7± 0.7	35.6		-

The antimicrobial activities of aqueous (water), n-hexane, methanolic, and ethyl acetate extract from leaves of *Verbascum thapsus* against *Pseudomonas aeruginosa* are shown in Table 3. Data presented that *pseudomonas aeruginosa* showed susceptibility to all extracts. Highest significant activity was showed by n-hexane 50.4%, 40.7% and 35.85 ZI at all three (1, 2 and 3 mg/disc) concentrations, respectively. Crude (methanol), ethyl acetate, and n-butanol also exhibited activities at the same three concentrations comparatively to control and other samples. Aqueous extracts showed good ZI at higher conc.

The data described in Table 4 showed antimicrobial activities of the extracts n-hexane, methanolic, ethyl acetate and aqueous extracted from leaves of *Verbascum thapsus* against *Xanthomonas campestris*. Data further show that *Xanthomonas campestris* showed susceptibility to all fractions except aqueous. Good activity was revealed by n-butanol and -. The highest activity was shown by ethyl acetate 41.6% ZI at 3 mg/disc concentration. The crude extract also showed the activity of 16.9, 25.2 and 30.8% ZI at 1, 2 and 3 mg/disc concentrations, respectively.

Table 3. Antibacterial effect of different solvents extracted samples from leaves of *Verbascum thapsus* on *Pseudomonas aeruginosa* growth.

		Zone of inhibition (ZI) in mm *Pseudomonas aeruginosa*			
Plant Extracts	**Conc. Of extract mg disc^{-1}**	**Mean ± S.D**	**Zone of Inhibition (%)**	**Positive control (Ciprofloxacin) (mm)**	**Negative control (DMSO) (mm)**
Crude (Methanol)	**1**	5.3± 0.0	22.0		-
	2	9.1± 0.1	37.9		-
	3	11.5± 0.5	47.9		-
n-Hexane	**1**	8.6±3.3	35.8		-
	2	11.3±1.0	47.0		-
	3	12.1± 0.8	50.4	24	-
n-Butanol	**1**	5.6±0.3	23.3		-
	2	6.9±0.4	28.7		-
	3	9.8±0.5	40.8		-
Ethyl acetate	**1**	8.1± 1.1	33.7		-
	2	10.5±1.5	43.7		-
	3	11.6±1.3	48.3		-
Aqueous	**1**	0.0±0.0	0		-
	2	5.5± 0.5	22.9		-
	3	7.4± 0.9	30.8		-

Table 4. Antibacterial effect of different solvents extracted samples from leaves of *Verbascum thapsus* on *Xanthomonas compestris* growth.

		Zone of inhibition (ZI) in mm *Xanthomonas compestris*			
Plant Extracts	**Conc. Of extract mg disc^{-1}**	**Mean ± S.D**	**Zone of Inhibition (%)**	**Positive control (Ciprofloxacin) (mm)**	**Negative control (DMSO) (mm)**
Crude (Methanol)	**1**	6.1±0.1	16.9		-
	2	9.1±0.1	25.2		-
	3	11.1±0.8	30.8		-
n-Hexane	**1**	6.0±0.5	16.6		-
	2	8.6±1.3	23.8		-
	3	10.0±1.0	27.7	36	-
n-Butanol	**1**	6.2±0.2	17.2		-
	2	6.6±0.6	18.3		-
	3	8.5±0.5	23.6		-
Ethyl acetate	**1**	11.6±0.3	32.2		-
	2	13.6±0.6	37.7		-
	3	15.0±0.4	41.6		-
Aqueous	**1**	0.0±0.0	0		-
	2	0.0±0.0	0		-
	3	0.0±0.0	0		-

Table 5. Antibacterial effect of different solvents extracted samples from leaves of *Verbascum thapsus* on *Bacillus subtilis* growth.

		Zone of inhibition (ZI) in mm *Bacillus subtilis*			
Plant Extracts	**Conc. of extract mg disc-1**	**Mean + S.D**	**Zone of Inhibition (%)**	**Positive control (Ciprofloxacin) (mm)**	**Negative control (DMSO) (mm)**
Crude (Methanol)	**1**	6.8±0.2	18.8	36	-
	2	8.6±0.3	23.8		-
	3	10.2±0.2	28.3		-
n-Hexane	**1**	7.8±1.8	21.6		-
	2	10.5±0.4	29.1		-
	3	12.0±0.0	33.3		-
n-Butanol	**1**	6.6±0.5	18.3		-
	2	9.5±0.5	26.3		-
	3	11.2±0.2	31.1		-
Ethyl acetate	**1**	11.7±1.6	32.5		-
	2	10.8±0.3	30		-
	3	12.9±0.3	35.8		-
Aqueous	**1**	0.0±0.0	0		-
	2	0.0±0.0	0		-
	3	9.1±0.1	25.2		-

Table 6. Antibacterial effect of different solvents extracted samples from the leaves of *Verbascum thapsus* on *Escherichia coli* growth.

		Zone of inhibition (ZI) in mm *Escherichia coli*			
Plant Extracts	**Conc. Of extract mg disc^{-1}**	**Mean ± S.D**	**Zone of Inhibition (%)**	**Positive control (Ciprofloxacin) (mm)**	**Negative control (DMSO) (mm)**
Crude (Methanol)	**1**	7.1±0.1	29.5	24	-
	2	10.4±0.4	43.3		-
	3	13.8±1.8	57.5		-
n-Hexane	**1**	8.0±1.5	33.3		-
	2	12.8±3.5	53.3		-
	3	12.6±1.8	52.2		-
n-Butanol	**1**	7.4±0.5	30.8		-
	2	9.4±0.4	39.1		-
	3	11.4±0.4	47.5		-
Ethyl acetate	**1**	9.1±0.1	37.9		-
	2	10.8±0.2	45		-
	3	12.4±0.4	51.6		-
Aqueous	**1**	0.0±0.0	0		-
	2	6.4±0.4	26.6		-
	3	8.1±0.1	33.7		-

Table 7. Antifungal effect of different solvents extracted samples from the roots of V*erbascum thapsus* on *Candida albicans* growth.

Zone of inhibition (ZI) in mm
Candida albicans

Plant Extracts	Conc. Of extract mg disc^{-1}	Mean ± S.D	Zone of Inhibition (%)	Positive control (Ciprofloxacin) (mm)	Negative control (DMSO) (mm)
	1	6.1±0.8	20.3		-
Crude	**2**	8.3±0.0	27.6		-
(Methanol)	**3**	10.1±1.1	33.6		-
	1	6.6±1.1	22		-
n-Hexane	**2**	9.6±0.6	32		-
	3	9.7±0.2	32.3		-
	1	6.4±1.1	21.3		-
n-Butanol	**2**	10.3±0.7	34.3	30	-
	3	11.0±0.7	36.6		-
	1	7.5±0.5	25		-
Ethyl acetate	**2**	8.6±1.3	28.6		-
	3	10.9±1.9	36.3		-
	1	0.0±0.0	0		-
Aqueous	**2**	6.1±0.1	20.3		-
	3	8.3±1.3	27.6		-

Table 8. Antibacterial effect of different solvents extracted samples from the roots of *Verbascum thapsus* on *Pseudomonas aeruginosa* growth.

Zone of inhibition (ZI) in mm
Pseudomonas aeruginosa

Plant Extracts	Conc. Of extract mg disc^{-1}	Mean ± S.D	Zone of Inhibition (%)	Positive control (Ciprofloxacin) (mm)	Negative control (DMSO) (mm)
	1	6.6±1.3	27.5		-
Crude	**2**	11.1±0.5	46.2		-
(Methanol)	**3**	12.4±0.1	51.6		-
	1	7.6±0.6	31.6		-
n-Hexane	**2**	11.8±0.5	49.1		-
	3	12.9±0.3	53.7		-
	1	5.6±0.3	23.3		-
n-Butanol	**2**	10.1±0.1	42.0	24	-
	3	11.2±0.6	46.6		-
	1	9.5±0.5	39.5		-
Ethyl acetate	**2**	12.3±0.0	51.2		-
	3	14.3±0.2	59.5		-
	1	0.0±0.0	0		-
Aqueous	**2**	0.0±0.0	0		-
	3	7.1±0.8	29.5		-

Table 9. Antibacterial effect of different solvents extracted samples from the roots of *Verbascum thapsus* on *Xanthomonas compestris* growth.

Zone of inhibition (ZI) in mm
Xanthomonas compestris

Plant Extracts	Conc. Of extract mg disc^{-1}	Mean ± S.D	Zone of Inhibition (%)	Positive control (Ciprofloxacin) (mm)	Negative control (DMSO) (mm)
	1	7.2±0.7	20		-
Crude	**2**	10.7±0.4	29.7		-
(Methanol)	**3**	12.2±0.1	33.8		-
	1	8.3±1.3	23.0		-
n-Hexane	**2**	11.7±0.5	32.5		-
	3	13.3±0.5	36.9		-
	1	7.8±0.8	21.6		-
n-Butanol	**2**	11.3±0.3	31.3	36	-
	3	13.4±0.2	37.2		-
	1	10.6 ±0.6	29.4		-
Ethyl acetate	**2**	13.8±1.5	38.3		-
	3	16.6±0.4	46.1		-
	1	0.0±0.0	0		-
Aqueous	**2**	6.3±0.3	17.5		-
	3	7.6±0.6	21.1		-

Table 10. Antibacterial effect of different solvents extracted samples from the roots of *Verbascum thapsus* on *Bacillus subtilis* growth.

Zone of inhibition (ZI) in mm
Bacillus subtilis

Plant Extracts	Conc. Of extract mg disc^{-1}	Mean ± S.D	Zone of Inhibition (%)	Positive control (Ciprofloxacin) (mm)	Negative control (DMSO) (mm)
	1	6.8±0.5	18.8		-
Crude	**2**	8.3±0.8	23.0		-
(Methanol)	**3**	9.9±0.3	27.5		-
	1	6.5±0.5	18.0		-
n-Hexane	**2**	8.3±0.3	23.0		-
	3	10.8±0.2	30		-
	1	6.0±1.0	16.6	36	-
n-Butanol	**2**	7.6±0.3	21.1		-
	3	8.6±0.6	23.8		-
	1	7.8±0.8	21.6		-
Ethyl acetate	**2**	9.3±2.0	25.8		-
	3	11.1±0.5	30.8		-
	1	0.0±0.0	0		-
Aqueous	**2**	0.0±0.0	0		-
	3	0.0±0.0	0		-

Table 11. Antibacterial effect of different solvents extracted samples from roots of *Verbascum thapsus* on *Escherichia coli* growth.

Zone of inhibition (ZI) in mm
Escherichia coli

Plant Extracts	Conc. Of extract mg disc^{-1}	Mean ± S.D	Zone of Inhibition (%)	Positive control (Ciprofloxacin) (mm)	Negative control (DMSO) (mm)
	1	5.8±0.2	24.1		-
Crude	**2**	10.6±3.3	44.1		-
(Methanol)	**3**	13.3±1.7	55.4		-
	1	7.4±0.5	30.8		-
n-Hexane	**2**	10.2±1.0	42.5		-
	3	11.8±0.2	49.1		-
	1	6.1±0.1	25.4		-
n-Butanol	**2**	8.4±0.5	35		-
	3	10.2±0.1	42.5		-
	1	7.1±0.1	29.5		-
Ethyl acetate	**2**	11.1±0.1	46.25		-
	3	11.6±0.3	48.3		-
	1	0.0±0.0	0		-
Aqueous	**2**	6.1±0.1	25.4		-
	3	7.5±0.5	31.2`		-

Data indicated that all fractions showed were effective to control the growth of *bacillus subtilis* (Table 5). The highest activity was shown by ethyl acetate fraction measuring 30, 32.5 and 35.8% ZI as compared to control. N-hexane and n-butanol also showed moderate activities at 3 mg/disc concentrations. The crude extract also inhibited the growth of the tested microbes at all concentrations. At 3 mg/disc concentration, aqueous extract inhibited the growth of *Bacillus subtilis.*

The antimicrobial activities of n-hexene, methanolic, ethyl-acetate and aqueous (water) extract from leaves of *Verbascum thapsus* counter to *Escherichia coli* showed in (Table 6). Data revealed that all fractions revealed activity against *Escherichia coli*. Maximum activity was shown by crude, ethyl acetate and n-hexane fractions measuring 57.5%, 53.3% and 51.6% ZI, respectively at 3 mg/disc concentrations as compared to control and other samples. N-butanol also showed activity measuring ZI 47.5%, at 3 mg/disc concentrations. The aqueous extract also showed good potential against the tested microbes.

Antimicrobial activities of different solvent extracted samples from the roots of *Verbascum thapsus*

N-hexane, methanolic, ethyl acetate and aqueous solvent extracted samples from the roots of *Verbascum thapsus* exhibited activity against *Candida albicans* (Table 7). Ethyl acetate and n-butanol fractions revealed 36.3 and 36.6% ZI at 3 mg/disc concentration which was the highest ZI among the data described. Data further suggested that n-hexane and crude fractions also showed good activities (32.3% and 33.6% ZI at 3 mg/disc concentrations). The aqueous extract also showed a zone of inhibition against the subject microbes.

The antimicrobial activity of five types of solvents extracted samples from the roots of *Verbascum thapsus* are reported in against *Pseudomonas aeruginosa* (Table 8). Analysis of the data showed that highest activities were shown by ethyl acetate and crude extracted (59.5, 51.2, 39.3% and 51.6, 46.2, 27.5% ZI at 3, 2 and 1 mg/disc, concentrations, respectively). N-butanol, n-hexane and aqueous extracted samples also showed good activity against the tested microbes at 3 mg/disc concentration.

The antimicrobial activities of five different solvent extracted samples from the roots of *Verbascum thapsus* were found against *Xanthomonas campestris*. Almost all extracted samples exhibited to be potent against

Xanthomonas campestris and showed highest ZI. Ethyl acetate samples were more effective at all concentrations (46.1, 38.3 and 29.4% ZI, respectively). N-hexane, n-butanol and crude extract were also effective at 3 and 2 mg/disc concentrations causing 36.9, 32.5, 37.2, 31.3% and 33.8, 29.7% ZI respectively. Aqueous extract was least potent.

Data showed that all extracted samples were effective against *Bacillus subtilis* except aqueous extract. Crude and ethyl acetate fraction restricted the *Bacillus subtilis* growth and showed 27.5, 23 and 30.8, 25.8% ZI at 3 and 2 mg/disc concentrations, respectively (Table 10). N-hexane and n-butanol showed also good zones of inhibition at all concentrations as compared to control.

The data revealed that all the extracted samples inhibited *Escherichia coli* growth. Data also disclosed that *Escherichia coli* were highly susceptible to fractions obtained from crude and n-hexane yielding 55.4, 44.1, 24.1 and 49.1, 42.5 and 30.8% ZI at 3, 2 and 1 mg/disc concentrations, respectively. Ethyl acetate and n-butanol also showed activities at all concentrations.

DISCUSSION

In our experiment, maximum activity against *Candida albican, Pseudomonas aeruginosa* and *Xanthomonas compestris* was observed using ethyl acetate fractions of *Verbascum thapsus* leaf at all concentrations when measured through disc diffusion susceptibility assay. However, highest activity was noted against *E. coli* using the same leaves extract. The data further showed that ethyl acetate fractions of both leaves and roots were effective to control the growth of all selected microbes at all concentrations. Our results are in agreement with previous findings, (Bakht *et al.*, 2014; Sautron; Cock, 2014 and Shakeri *et al.*, 2015).

The crude extracts from leaves and roots of *Verbascum thapsus* were effective against *Pseudomonas aeruginosa* and *E. coli* at the all concentrations upon comparing with other solvent samples and controls. On the contrary, this sample was less effective against *Bacillus subtilis.* Similar results were also demonstrated by Prakash *et al.* (2016) which reported that methanolic leaf extract was more effective against selected pathogenic bacterial spp. as compared to acetone leaf extract. Furthermore, the leaf extracts more effectively inhibited the growth of gram-positive bacterial strains than gram-negative bacteria. The findings of Khanam *et al.* (2015) also delivers similar activities for crude extracts of *E. longifolia* showing high levels of bioactive compounds.

Verbascum thapsus substantially inhibited the growth of the tested microbes at all concentrations. Among the tested samples, n-butanol extracted fractions showed the highest activity against *E. coli* and *pseudomonas aeruginosa* at all concentrations compared to control and other solvent extracted samples. However, *Candida albican* was highly susceptible to n-butanol fraction from leaves and roots of *Verbascum thapsus* than other microbes. Furthermore, n-butanol fractions of roots exhibited higher activity than leaves. This may be due to bioactive compounds present in leaves compared to roots. The results are similar to Armatu *et al.* (2011) who investigated antibacterial properties of several parts of *Verbascum* plants. N-butanol activities were also shown to be effective in extracts from different flowering plants against various microbes (Talib and Mahasneh, 2010). The activity of n-butanol extract of *Allium cepa* is also recorded by Bakht *et al.* (2013).

N-hexane extracted fractions from leaves and roots repressed the growth of the tested microbes at all concentrations. These fractions have shown higher activities against *P. aeruginosa* and *E. coli* when tested at higher concentrations. However, *B. subtilis and Xanthomonas compestris* showed minimum inhibitory activity at all concentrations against fractions from both parts of the source plant. C*andida Albicans* showed moderate inhibition to n-hexane fractions from both leaves and roots. These results are in contradiction with Vogt *et al.* (2010) who reported antifungal activity mainly in methanol extract against *Fusarium graminearum* and *Macrophomina phaseolina*. The activity of N-hexane extracts was also shown to be low in the studies of Sautron and Cock, (2014).

All microbial strains were susceptible to aqueous (roots) sample except *Xanthomonas compestris* (leaves samples) and *Bacillus subtilis.* At extreme concentrations of our tests, all the bacteria (growth) tested were inhibited by the aqueous samples from roots and leaves of *Verbascum thapsus* showing that bioactive compounds were dissolved to a greater extent in water. Aqueous extracted samples from roots and leaves of *Verbascum thapsus* plant showed reasonable activity against *Candida albicans.* These results are in agreement with Armatu *et al.* (2011), and Bakht *et al.* (2014).

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