Antimicrobial, Antioxidant and Phytotoxic Assessment of *Agave Americana, Mentha Spicata and Mangifera Indica L.* Extract

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Abstract

Purpose: The research study was prototyped to assess pharmacological activities (antimicrobial, anti-oxidant, phytotoxic and haemagglutination) of *Agave americana*, *Mentha spicata* and *Mangifera indica* leaves extracts. The positive outcomes of the study can aid in formulations of novel therapeutic opportunities by using natural, eco-friendly, and economic raw materials having least side effects and aced potency.

Method: Leaves extracts of *Agave americana*, *Mentha spicata* and *Mangifera indica* were prepared using analytical grade ethanol, methanol, acetone and n-hexane. Then the extracts were subjected to antibacterial, antifungal, antioxidant, phytotoxic and haemagglutination assay. Well-diffusion antibacterial protocol was followed against pathogenic bacteria. Tube dilution antifungal protocol was followed against pathogenic fungi. DPPH radical scavenging assay at variable sample dilutions was followed for antioxidant assay. *Lemna minor* lethality assay was followed for phytotoxic assay. Haemagglutination assay were assessed against ABO blood groups.

Results: Crude leaves extracts (aqueous, acetone, methanolic and ethanolic) of preferred plants i.e., *Agave americana*, *Mentha spicata* and *Mangifera indica* owned superlative antimicrobial efficacy against all test micro-organisms specifically *Escherichia coli* ((91%), *Pseudomonas aeroginosa* (85%), *Methicillin resistant Staphylococcus aureus* (81%) and mycelium of *Fusarium oxysporum* (85%) was halted by *Agave americana* leaves extracts. In comparison to these crude extracts of *Mentha spicata* terrifically halted growth of *Proteus mirabilis* (80%) while leaves extracts *Mangifera indica* halted growth of *Streptococcus griseus* (90%) respectively. Excellent antioxidant and phytotoxic efficacy were

recorded at higher sample concentrations. No haemagglutination efficacy recorded.

Conclusion: From the study it was concluded that leaves of *Agave americana*, *Mentha spicata* and *Mangifera indica* possess excellent antimicrobial potentials which can aid to formulation new antibiotics having excellent effects in least doses. These extracts can also be used to treat many maladies by eliminating reactive oxidants and promoting healthy metabolism. These extracts can also be utilized as ecofriendly and user-friendly herbicide.

Keywords: *Agave americana*, *Mentha spicata*, *Mangifera indica, biological screening*

Introduction

Role of medicinal plants in health care management is not new to modern era, its roots are even found in various ancient scriptures. Nearly, two third of all the plant species currently known to mankind are found to be possess medicinal prospective (Krishnaiah et al., 2011). Medicinal plants possess a wide array of bioactive constituents that are therapeutic in nature and therefore are used in formulation of various drugs to curtail several metabolic syndromes (Sofowora et al., 2013). Owing to their ease of availability, low price, and nontoxic origin these medicinal plants are being currently practiced as an alternative source of synthetic drugs. It has also been reported that nearly 500 medicinal plant species have been explored by scientists for their use in the preparation of numerous contemporary drugs (Chopra, 1956). According to WHO (World Health Organization), approximately 80% of world's residents count on traditional medicine to fulfil their basic health care needs. Furthermore, health care management from these medicinal plants implicates the usage of extracts and biologically active components isolated from them (Joshi et al., 2011).

Southern Asia countries like Pakistan, India, Nepal, and Bangladesh are known to have numerous varieties of medicinal plants that are recognized around the globe for their health escalating potentials. Unfortunately, most of these medicinal plants are only being used in indigenous medications like Ayurveda & Unani system of medicine and authentication from scientific investigations are still required for their use as alternative medicine to synthetic drugs (Bashir et al., 2019). Purposely, medicinal plants (*Agave americana*, *Mentha spicata,* and *Mangifera indica*) studied in this investigation are most commonly used by indigenous Pakistani people for the cure of various ailments.

Among mentioned medicinal plants, *Agave Americana* is actually a xerophytic plant that is indigenous to Mexico. It is most commonly known as American aloe or sentry plant and belongs to family Asparagaceae (Bailey et al., 1976). This medicinal plant is also cultivated in Asian countries including Pakistan and India as an ornamental plant. It has long succulent leaves with distinct white flowers (Gilman, 1999; Kīrtikara et al., 2001). Despite its decorative purpose, this plant is being used as blood purifier, wound healer, diuretics, laxative, and eye mollifier (Misra et al., 2017). Further, *Agave americana* also possesses antimicrobial, antiseptic, anti-inflammatory, and anti-leishmanial properties (Kadam et al., 2012; Misra, et al., 2018; Thakur et al., 2015). Different parts of this medicinal plant including leaves and roots have shown capability to combat hepatic, nephritic, and dental maladies. Similarly, it has revealed ability to treat malaria, syphilis and tuberculosis. Pharmacological properties of *Agave Americana* is mainly due to the presence of bioactive components in various parts of the plant (Gizynska et al., 2007; Kadam et al., 2012).

Mentha spicata, prominently known as Spearmint is local European and Asian rhizomatous abiding herb that belongs to family Lamiaceae. The herb grows unexcelled in temperate regions utilizing wet loamy soils consisting of profuse organic material. Spearmint teas are advised by folk medicine practitioners to reduce stomach ache and hirsutism in women (Grant, 2010; Hussain et al., 2010). *Mentha spicata* extracts also has tremendous antifungal, antibiofilm, anti-proliferative, antimicrobial, and antioxidant potentials (Bardaweel et al., 2018; Stringaro et al., 2018). It is also used as digestive cleansers and its oils are used as mild calmative and laxative. Presence of active fresheners compounds such as menthol and menthone makes it ideal to be used in confectionaries, soaps, toothpastes and shampoos (Kanatt et al., 2007). *Mangifera indica*, generally called as Mango belongs to family Anacardiaceae. This plant is cultivated efficiently in warm regions across the globe. Various parts of the plant have been exploited by .comtraditional medicine due to their significant pharmacological and phytochemical properties (Scartezzini et al., 2000). Studies have testified that *Mangifera indica* exhibit antipyretic, antidiabetic, anti-oxidant, antispasmodic, anti-tumor, antimicrobial, anti-allergic, and anti-inflammatory properties. Extracts of plant body also hypotensive, immunomodulatory, hypolipidemic, hepato-protective, cardio-protective and gastro-protective potentials (Aswal et al., 1984; Muruganandan et al., 2002).

In order to authenticate the use of these plants as medicine, there is a dire need to evaluate the efficacy and safety of above mentioned plants. Therefore, this study was planned to verify the antibacterial, antifungal, antioxidant, phytotoxic and haemagglutination attributes of various extracts (aqueous, acetone, methanolic, and ethanolic) from leaves of *Agave americana, Mentha spicata* and *Mangifera indica*.

Materials and Methods

Collection of Plant Materials

On March 2013, leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* were procured from District Peshawar, Khyber Pukhtoon-Khwa (KPK), Pakistan. Leaves of all the three plants were identified and differentiated by Ghulam Jelani from Botany Department in University of Peshawar, Pakistan.

Extraction Procedure

Initially, leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* were separately dried under shade. Afterwards, they were ground to fine powder (1 Kg each) with the help of commercial electric grinder. Collected fine powder of each plant leaves were individually steeped in analytical grade acetone, methanol, and ethanol for a period of two weeks at 25^{o}C. On the other hand, for collection of aqueous extracts, 25 g powdered plant material each from *Agave americana, Mentha spicata,* and *Mangifera indica* leaves were boiled in 500 mL distilled water for 30 minutes. All the four resultant mixtures were later on subjected to filtration (Whattmans filter paper) followed by evaporation of extracting solvent under vacuum condition at 40^{o}C using rotary evaporator, respectively. Finally crude plant extracts of blackish green color was acquired having weight of 150g each.

Extract Analysis

Antibacterial Screening

For antibacterial screening of all the extracts collected individually from leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* obtained by treating with four (aqueous, acetone, methanol, and ethanol) solvents was conducted by assessing their potential against virulent bacterial species such as *Pseudomonas aeruginosa (PA), Methicillin resistant Staphylococcus aureus (MRSA), Vancomycin resistant Staphylococcus aureus (VRSA), Proteus mirabilis, Escherichia coli, Streptomyces griseus and Bacillus subtilus* as per documented procedure (Shahzada et al., 2013).

Purposely, autoclaved test tubes were used for incubation of prepared sterile nutrient broth for 24 hours at 37°C. The broth was then inoculated with the selected bacterial species. On the same day, autoclaved petri plates were also used for incubation of prepared sterile nutrient agar media for 24 hours at 37°C prior to sterility test. Afterwards, cultured broth was spread thoroughly on to the prepared petri-plates. For formation of wells in nutrient agar media, 6 mm flame sterilized borer was used. Further 3 mg/ml stock solution of the crude plant extracts was prepared by utilizing DMSO (<1%). In order to better the diffusion of stock solution into the prepared media, 100µl aliquots from stock solution was designated to the wells followed by settling in laminar flow hood. Amoxicillin drug was used as positive control and DMSO (<1%) was used as negative control. Zone of inhibition (mm) by test organisms were measured after 24 hours of incubation. And bacterial percent growth inhibition was computed using formula;

$$\text{Percent Growth Inhibition} = \frac{\text{Zone of Inhibition of Sample (mm)}}{\text{Zone of Inhibiton of Standard (mm)}} \times 100$$

Antifungal Screening

Crude aqueous, acetone, methanolic, and ethanolic extracts collected from leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* was examined for possible antifungal screening as per documented protocols against *Verticillium*, *Aspergillus niger, Aspergillus parasiticus, Fusarium oxysporum, and Penecillium* as virulent test fungal species (Shahzada et al., 2013).

For this purpose, stock solution of each extracts were prepared using DMSO (<1%). Then Sabouraud Dextrose Agar media was prepared for growth of fungal mycelia. Afterwards, 66.6 µl stock solutions were designated to autoclaved test-tubes already containing 4ml autoclaved SDA media and were allowed at inclined position for solidification. Supplemented media was finally inoculated with the selected fungal species. For comparison purpose, Miconazole drug acted as positive control and sterile DMSO (<1%) as negative control. All the cultured test tubes were incubated for a week at 28°C. On the termination of incubation period, linear fungal mycelia growth was noticed. Growth inhibition (%) was calculated through following formula;

$$\text{Percent growth Inhibition} = 100 - \frac{\text{Linear growth in test sample(mm)}}{\text{Linear growth in control (mm)}} \times 100$$

Antioxidant Screening

Antioxidant screening of crude acetone, methanolic and ethanolic extracts collected from leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* were analyzed for

their potential to eliminate the free radicals. Purposely, DPPH-assay was employed for the screening of antioxidant characteristics by following the documented protocols (Khalil et al., 2017; Shahzada et al., 2013). The reaction mix comprised of DPPH (100 μM) in methanol and various concentrations (100, 200, & 300 μg ml^{-1}) of tested plant extracts. Absorbance was calculated at 517nm after giving stay time of 30 minutes at 25^{o}C. At the end of experimentation, antioxidant potentials for each plant extract was calculated as percentage radical reduction. Experiment was conducted in triplicate. DPPH was used as a reference compound.

$$\textbf{Percent Absorbance} = \frac{\textbf{Control Absorbance} - \textbf{Extract Absorbance}}{\textbf{Control Absorbance}} \times 100$$

Phytotoxic Screening

Crude plant extracts (aqueous, acetone, methanol, & ethanol) from leaves of three experimented medicinal plants were estimated for their phytotoxic potential against *Lemna minor L* by following the documented protocol (Shahzada et al., 2013). For this trait, stock solution (30 mg mL^{-1}) for each plant extracts was prepared in analytical grade methanol (1 mL). For proper proliferation of *Lemna minor,* E-medium was prepared. Test samples at various concentrations (10, 100, & 1000 μg mL^{-1}) prepared from stock solutions were applied on the already autoclaved petri-plates. Afterwards, for the removal of methanol, they were left at 25^{o}C. After evaporation of methanol, E-medium (20 mL) was added into all petri plates followed by addition of sixteen healthy plants. This system was further subjected to incubation (28^{o}C) for 1 week. In this experimentation, Paraquat was designated as standard herbicide. After incubation, results were calculated and number of damaged plants were noted. Following formula was used for calculation of percent growth regulation;

$$\textbf{Percent growth regulation} = \frac{\textbf{Experimental Test Sample}}{\textbf{Standard}} \times 100$$

Haemagglutination Screening

Hemagglutination screening of all four extracts (aqueous, methanol, ethanol, & acetone) collected from leaves of *Agave americana, Mentha spicata,* and *Mangifera indica* were calculated using documented protocol (Shahzada et al., 2013). Various dilutions (1:2, 1:4, 1:8, & 1:16) were prepared at pH 7 by using phosphate buffer. For this purpose, human blood from healthy individuals were subjected to centrifugation. Phosphate buffer was used in case of all the experimented blood groups for the formulation of 2% erythrocyte suspension. To check the haemagglutination activity, 1 mL each from test sample & 2% erythrocyte suspension was mixed and incubated at 37^{o}C for 30 min. Results of this analysis were considered negative and positive on formation of smooth button and rough granule, respectively.

Results and Discussion

Antibacterial Screening

From the antibacterial investigation against test organisms, it was perceived that crude extracts of stipulated plants possessed phenomenal antibacterial potentials. *Agave americana* crude extracts were excellently effective against *E.coli* (91%), *Pesudomoas*

aeroginosa (85%) and *Methicillin resistant Staphylococcus aureus* (81%) respectively. While crude extracts of *Mentha spicata* possessed tremendous to good activity against all test bacterial species particularly *Proteus mirabilis* (80%), *Vancomyscin resistant Staphylococcus aureus* (73%) and *Pseudomonas aeroginosa* (74%). Finally *Mangifera indica* crude extracts also exhibited splendid antibacterial potency against *Streptococcus grieus* (90%). Results are summarized in *(Fig. 1 - 3).*

Antibacterial potential of all the examined extracts from leaves of *Agave americana* might be due to the existence of homo-isoflavanoids and tetratriacontanol derivatives (Amin et al., 2010). Extracts of *Agave* genus have been reported to show significant inhibitory and bactericidal effect against various Gram positive and Gram negative bacterial strains (Ade-Ajayi et al., 2011; Hammuel et al., 2011). This potential of *Agave* extracts may be ascribed to the presence of identified bioactive components like tannins, saponins, flavonoids, steroids, and glycosides (López-Romero et al., 2018). Furthermore, compositional analysis of hydro-distilled aerial portion of *Mentha spicata L. (Spicata)* showed major components to be carvone (48%) and 1, 8-cinele (21%). These compounds were known to possess significant anti-bacterial activities (broth micro-dilution & disc diffusion methods) against *E. coli, C. albicans, C. tropicalis* and *S. aureus (Şarer et al., 2011).* Results of our present investigation are in harmony with earlier findings of Hussain et al. (Hussain et al., 2010). They investigated the anti-bacterial activity of spearmint oil against *S. aureus, E. coli, B. subtilis*, & *P. multocida* and concluded that these strains were positively affected by application of *Mentha spicata* extracts. Antibacterial potency of *Mangifera indica* leaves extracts has also been demonstrated and is prescribed by traditional herbalists as a poultice in Uganda (Bbosa et al., 2007). It has been reported effective against many oral bacterial species such as *Actinobacillus actinomycetemcomitans, Fusobacterium nucleatum, Porphyromonas gingivalis, Prevotella intermedia,* and *Peptostreptococcus micros (Bairy, et al., 2002)*. Hydrodistilled oils of *Mentha spicata* leaves have also been reported to inhibit vast species of medically pathogenic bacterial species (Aggarwal et al., 2002).

Numerous studies have revealed the potential of polyphenolic constituents in alteration of bacterial (Gram positive & gram negative) membrane properties mainly due to variation in membrane hydrophobicity, integrity, and surface charge. These changes cause rupturing of membrane and leakage of intracellular material, eventually leading to cell death (Lopez-Romero, et al., 2015; Monte et al., 2014). Further, other scientists have concluded that anti-bacterial effect of phenolic rich extract might be due to inhibitory action on activity of vital enzymes and nucleic acid synthesis (Thirumurugan et al., 2010). Significant association has been reported among anti-bacterial properties of polyphenols (saponins & terpenoids) and their molecular size, structure, and hydrophobicity. Outcomes of this study will open new horizons regarding the use of extract from leaves of *Agave americana*, *Mentha spicata,* and *Mangifera indica* as an anti-bacterial agent against clinical & food borne pathogens.

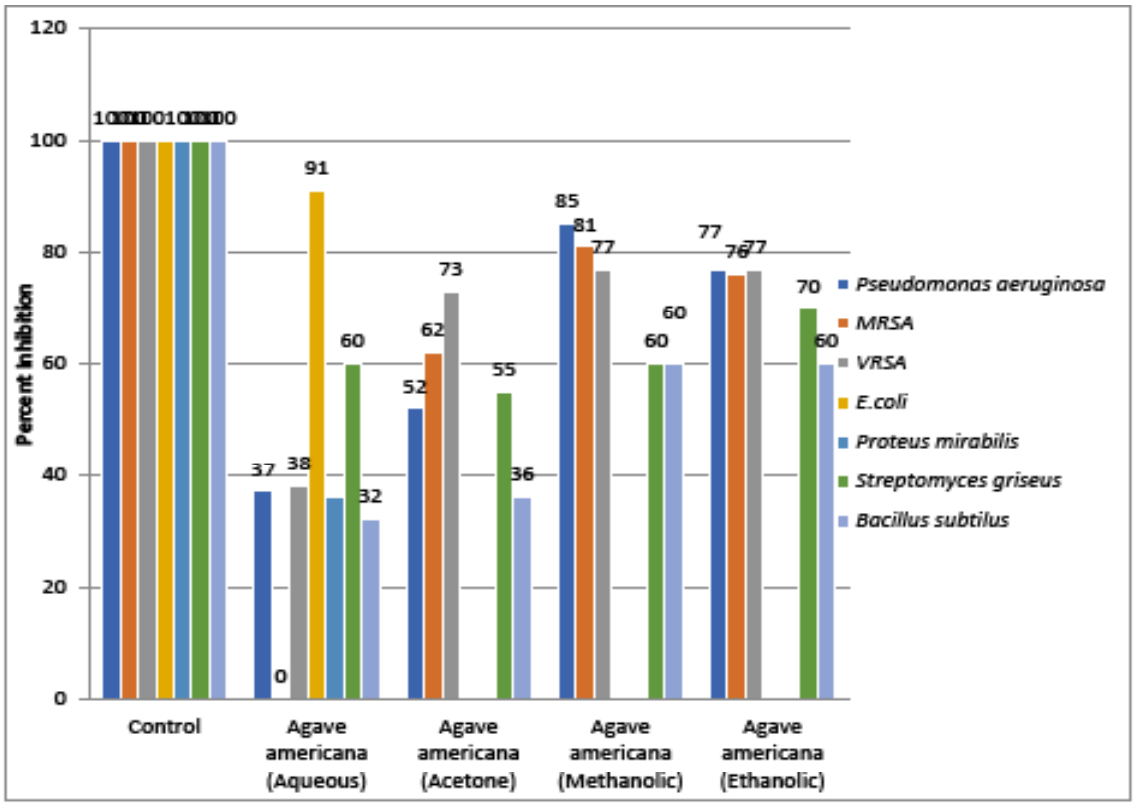

Figure 1. Percent growth regulation of crude *A. americana* extracts against stipulated virulent bacterial species

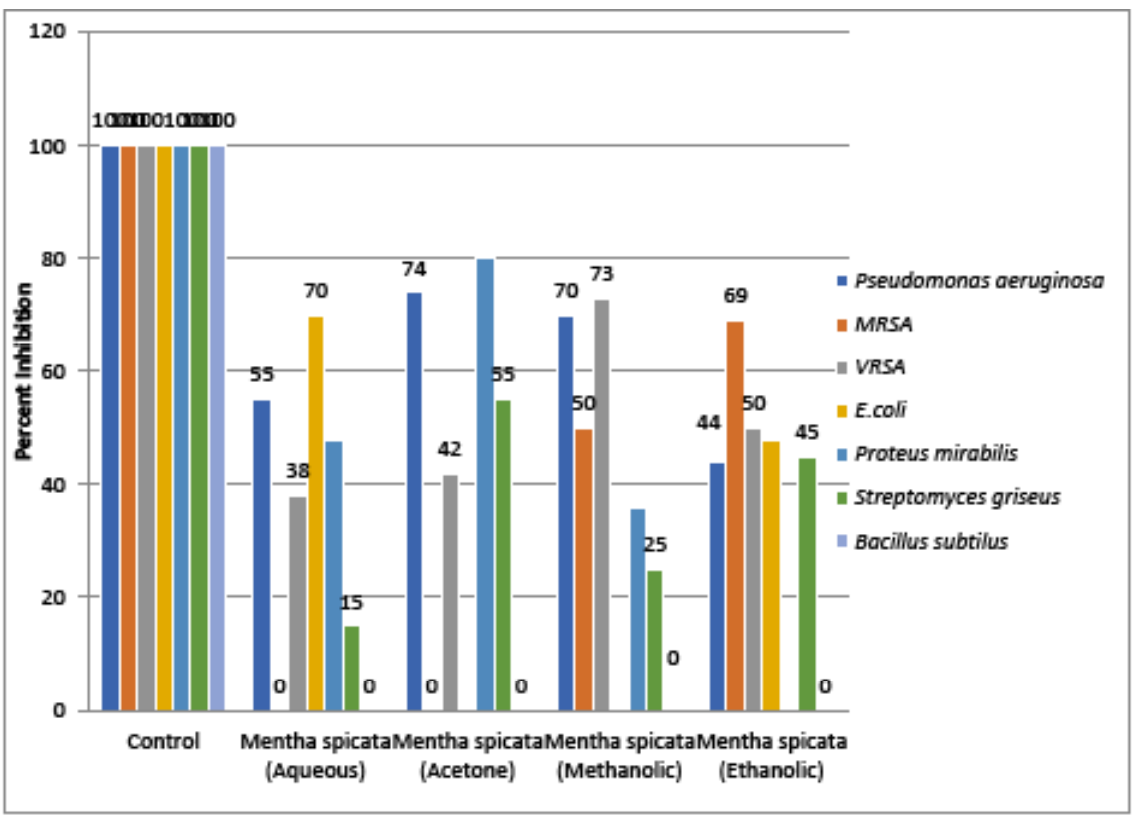

Figure 2. Percent growth regulation of crude *Mentha spicata* extracts against stipulated virulent bacterial species

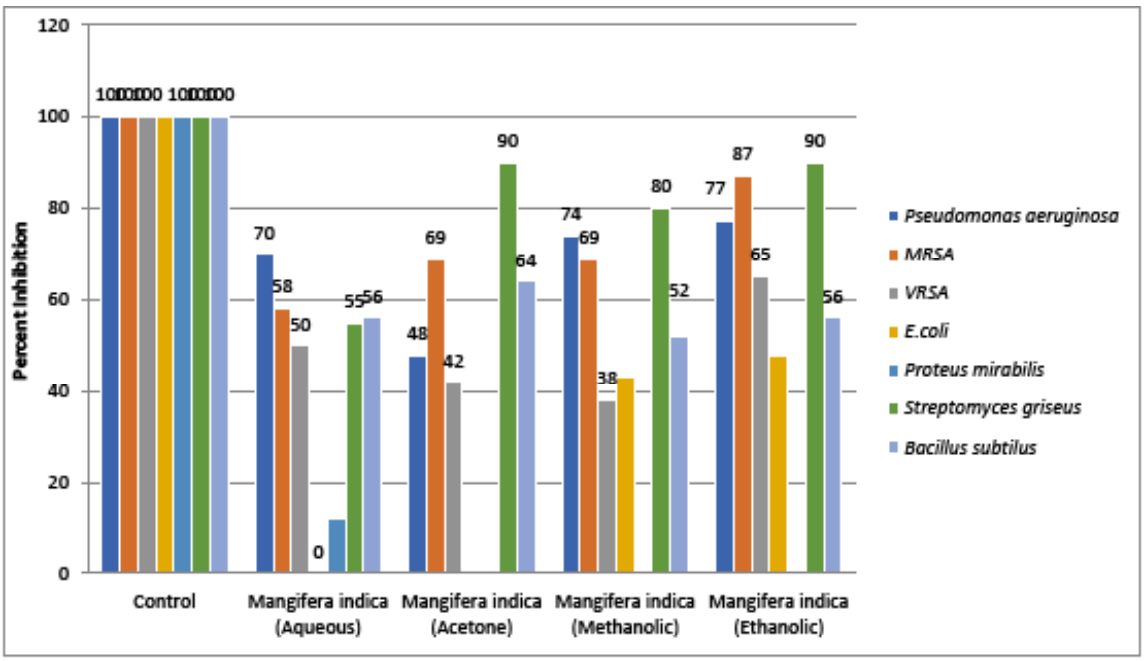

Figure 3. Percent growth regulation of crude *Mangifera indica* extracts against stipulated virulent bacterial species

Antifungal Screening

From the antifungal investigations against the test organism it was perceived that crude extracts of *Agave americana* leaves were outstandingly effectual against *Fusarium oxysporum* (85%), while rest of the fungal species were moderately inhibited. Following *Mentha spicata* exhibited good to moderate antifungal potency against *Verticillium* (64%), *Fusarium oxyspourum* (57%) and *Aspergillus niger* (53%) respectively. Satisfactory inhibitions were perceived by *Mangifera indica* crude leaves extracts peculiarly *Aspergillus niger (*73%). Results are summarized in *(Fig. 4 - 6)*.

Results of current study are in accordance with earlier findings of Stringaro et al. (Stringaro et al., 2018). They were of the view that essential oil extracted from *Mentha* species possess antifungal activities against various pathogenic fungi. Carvone and limonene were the main components present in essential oils from *M. spicata (Powers et al., 2018).* These bioactive biomolecules were responsible for antifungal activity of essential oil extracted from *M. spicata* against *Aspergillus* spp. (MIC: 890 to 2225 µg/mL) (Stringaro et al., 2018). *Mentha spicata* leaves extracts and its oils was reported to inhibit mycelial growth of *Fusarium oxysporum*, *Malassezia furfur, Trichosporon beigelii* and *Trichophyton rubrum* (Adam et al., 1998). Methanolic extract of leaves from *A. americana* have already been explored for its antifungal activity against the causal agent of *Alternaria* blight of Indian mustard (Guleria et al., 2009). Similarly, extracts of *A. americana* leaves have been found to significantly minimize the fungal growth of *Postia placenta* (causal agent of wood decay). *A. americana* revealed inhibition (64%) of hyphal growth (Siddhapura et al., 2011). Anti-fungal activity of plants within same specie might be due to varied chemical composition of each plant (Verástegui et al., 2008). Flavonoids isolated from *Mangifera indica* leaves at variable concentrations reported to have (82%-96%) activity against *Aspergillus niger, Aspergillus fumigatus, Alternaria alternata, Macrophomina phaseolina* and *Penicillium citrii (Singh et al., 1994).* Difference in the potent anti-fungal properties of these three plant extracts may be due to diversity in

phytochemical composition. Antifungal effect of medicinal plant extracts depends upon the extraction method, phyto-chemistry, and part of plant from which they are being extracted (Bayan et al., 2018).

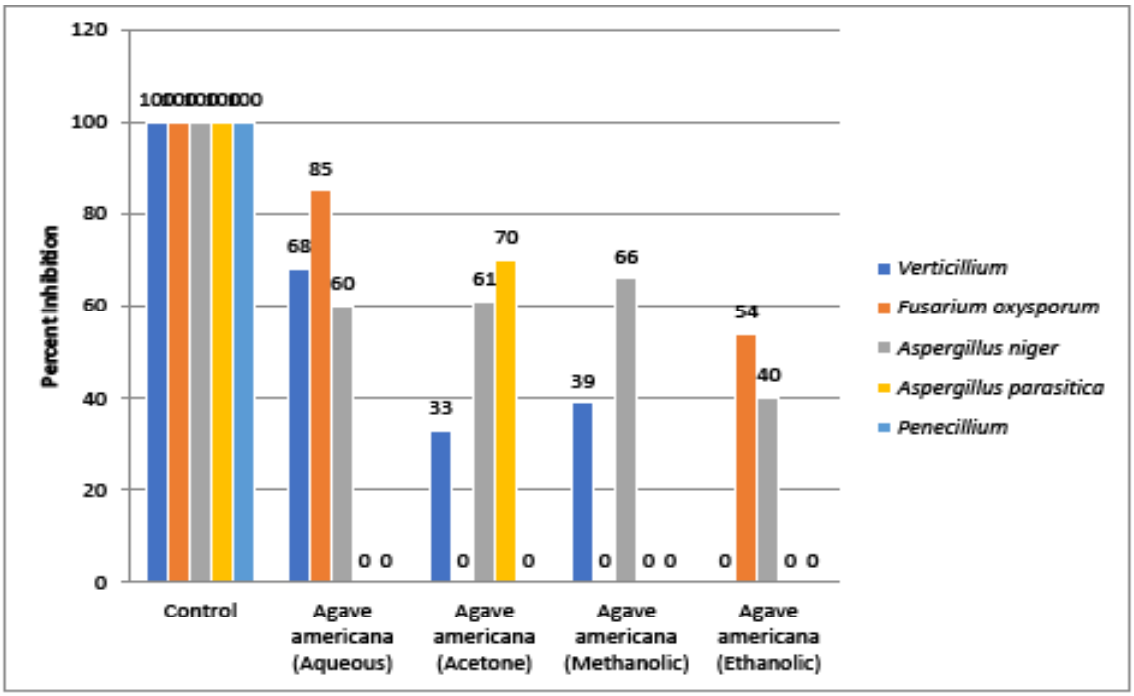

Figure 4. Percent growth regulation of crude *Agave americana* extracts against stipulated virulent fungal species

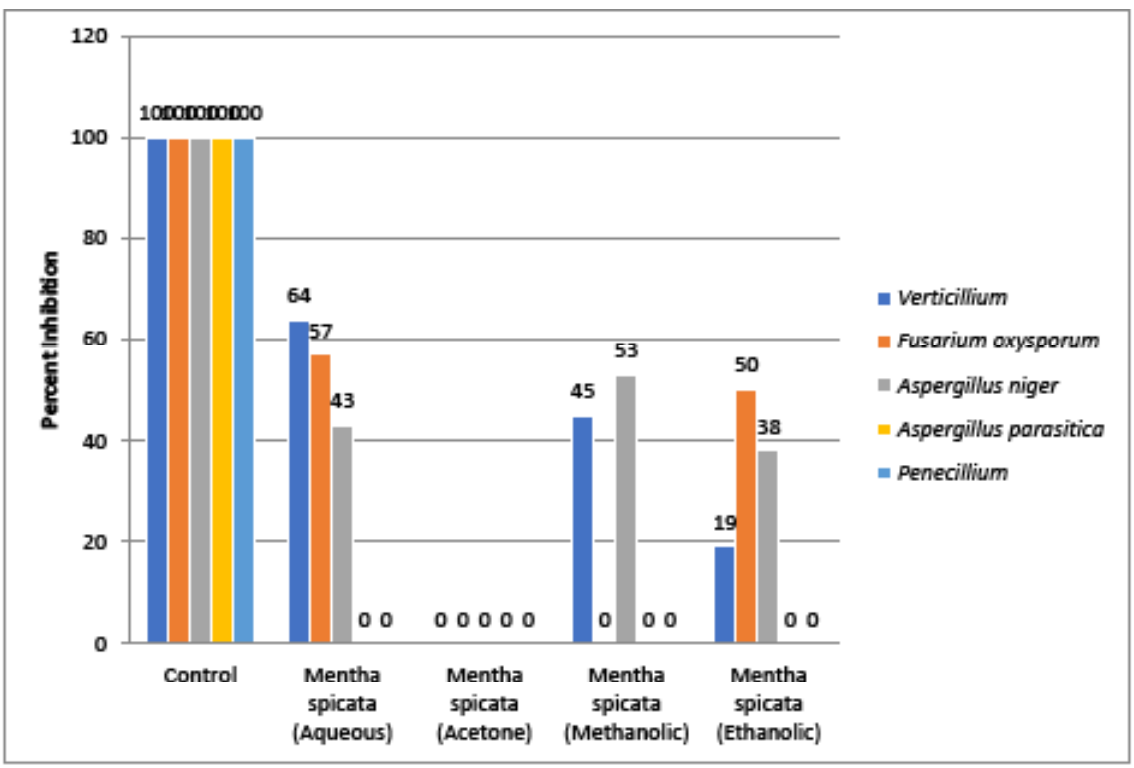

Figure 5. Percent growth regulation of crude *Mentha spicata* extracts against stipulated virulent fungal species

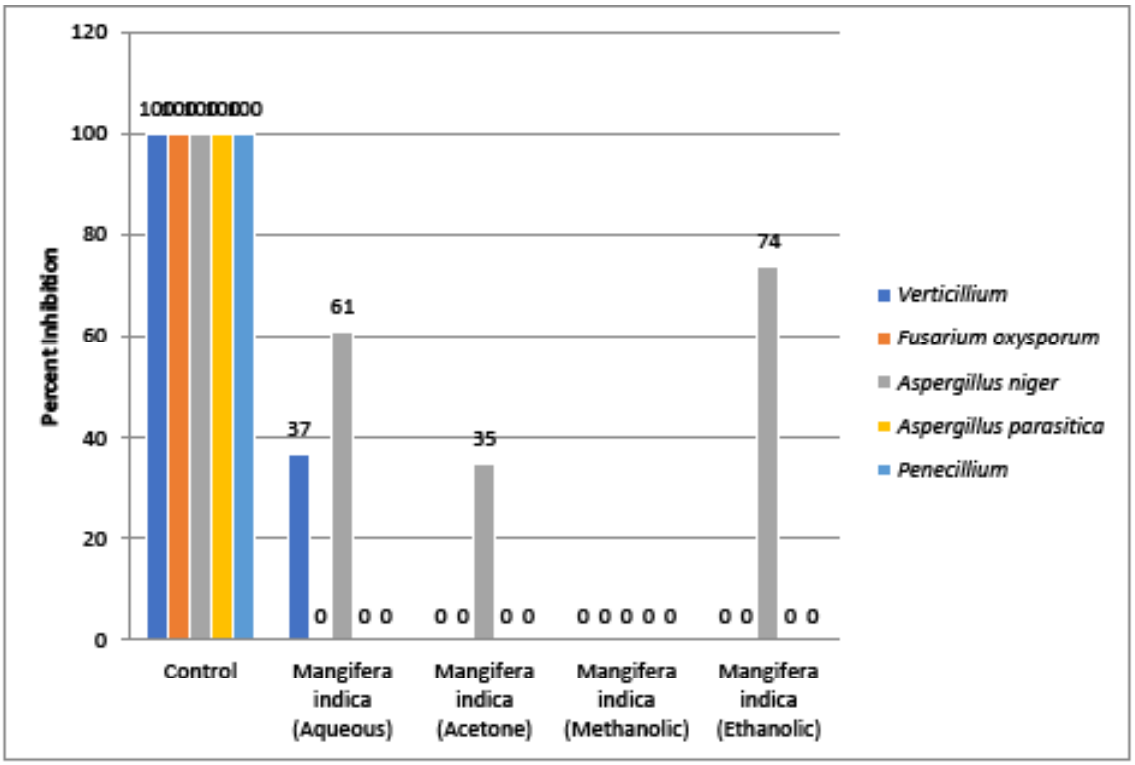

Figure 6. Percent growth regulation of crude *Mangifera indica* extracts against stipulated virulent fungal species

Antioxidant Screening

From antioxidant investigations it was perceived that crude leaves extract of *Mentha spicata,* and *Agave americana* exhibited highest (83 & 82%) antioxidant potentials at highest concentration (300 µL) when extracted with aqueous solvent. While least antioxidant potential was observed as 55 & 53% in extracts collected by using acetone and ethanol as extracting solvents. On the other hand, *Mangifera indica* extracts possessed moderate antioxidant potency (50-76%) as compared to extracts of other two plants extracted using four different solvents. These results are summarized in *(Fig. 7 - 9).*

Essential oils extracted from aerial portion of *M. spicata* (Spearmint) grown in Pakistan has been elucidated for its anti-oxidative potential. Polyphenolic characterization of extracted essential oil were reported to be abundant source of two bioactive compounds *i.e.* Carvone, and cis-Carvone. Further, antioxidant properties of essential oil, Carvone, and cis-Carvone from spearmint were examined and found out to be as 13, 19, & 15 µg/mL, respectively (Hussain et al., 2010). Supercritical extraction of spearmint leaves have been reported to possess up to 71% antioxidant potential calculated using DPPH-radical scavenging assay (Mandana et al., 2011). Extracts of seeds and flowers of *Mangifera indica* are found to be in the range of 54.6 to 79.8% & 21.1 to 86.6% when extracted with different solvents (Kamble et al., 2016). Scavenging capability of extracts from various plants using different solvents could vary depending upon the polyphenolic concentration, polarity of solvent used for extraction and part of plant from which they are being extracted (Ade-Ajayi et al., 2011; Khalil et al., 2018).

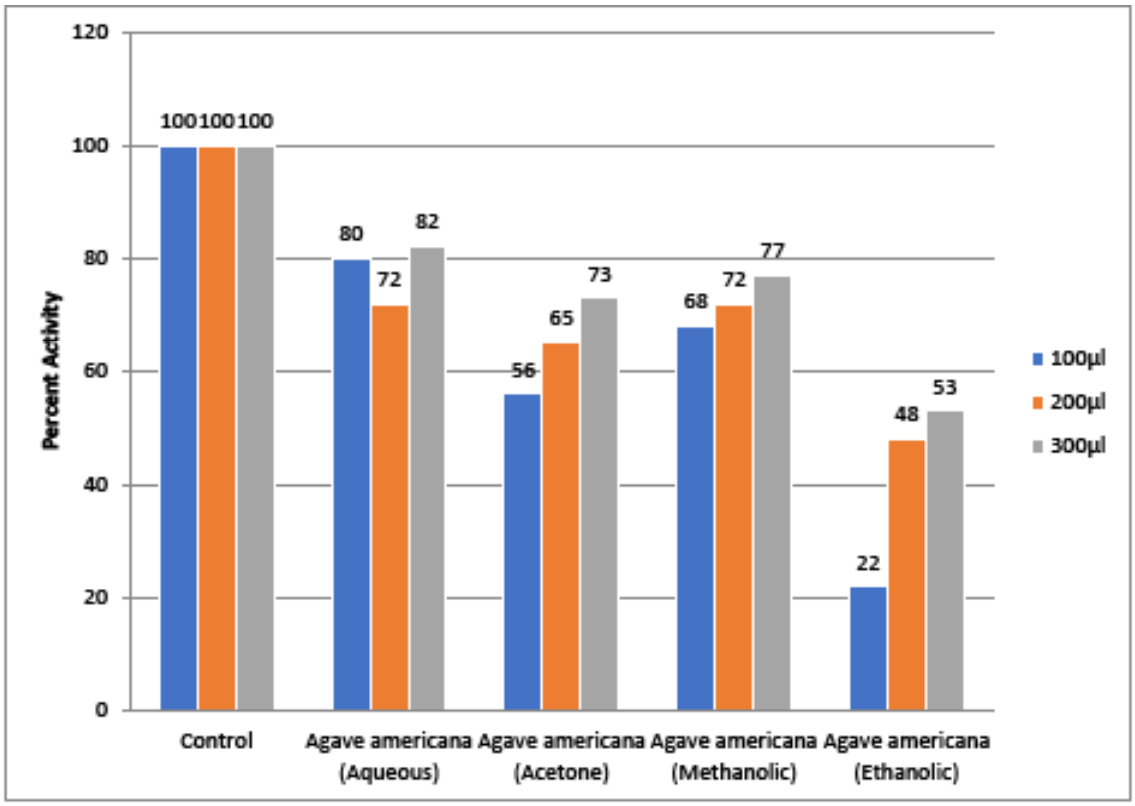

Figure 7. Percent antioxidant activity of *Agave americana* at variable concentrations

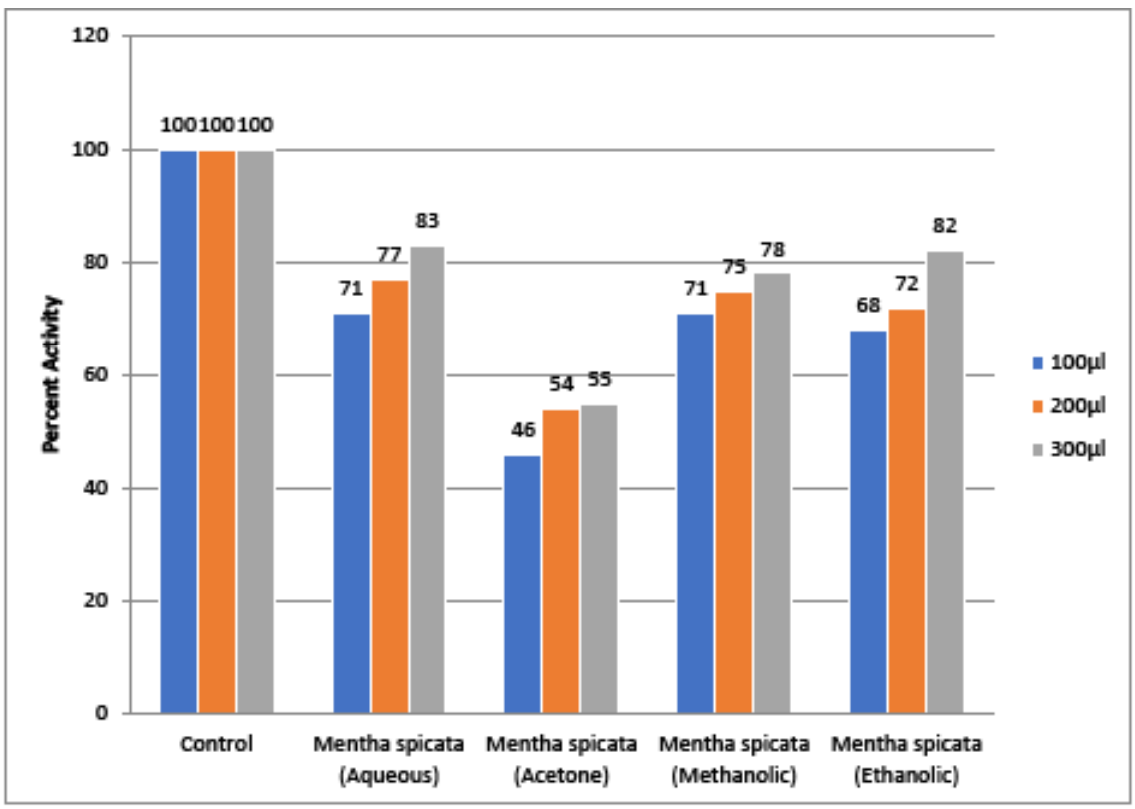

Figure 8. Percent antioxidant activity of *Mentha spicata* at variable concentrations

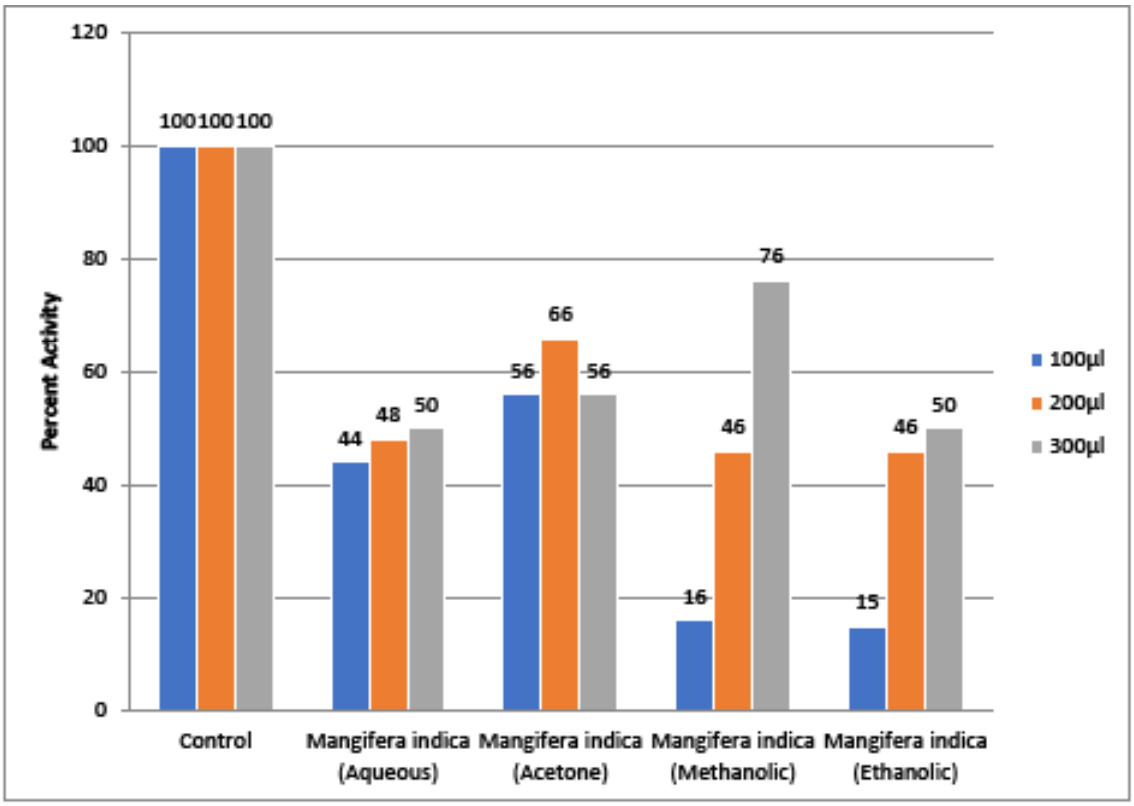

Figure 9. Percent antioxidant activity of *Mangifera indica* at variable concentrations

Phytotoxic Screenings

All the examined plant were analyzed for their phytotoxic activity against *Lemna minor L* at different concentrations *i.e.* 10, 100, and 1000 µL. Result of our current study showed that ethanolic leaf extract of *Mangifera indica* possessed maximum (81%) phytotoxic activity followed by aqueous (69%), acetone (62%), and methanolic (31%) extracts at highest concentration (1000 µL). Likewise, in case of *Agave Americana* leaf extracts, highest phytotoxic potential was observed as 63% when extracted with solvent acetone, while least (31%) was observed for ethanolic extract at 1000 µL-concentration. However, the phytotoxic activity of *Mentha spicata* leaf extracts were noticed to be least as compared to other examined plant extracts *(Fig. 10 - 12).*

Results of this present study are in agreement with earlier published data of Ahmad et al. (B. Ahmad et al., 2016). They were of the view that bio-nanoparticles of *M. indica, A. americana,* and *M. spicata* possessed phytotoxic potential in range of 13 to 88%. Inhibitory effect on vascular bundles might be the reason for their strong herbicidal-potential. Outcomes of this study might be helpful in providing baseline information for herbicides manufacturing industries to use plant based extracts to produce non-toxic and eco-friendly herbicides (Khattak et al., 2019).

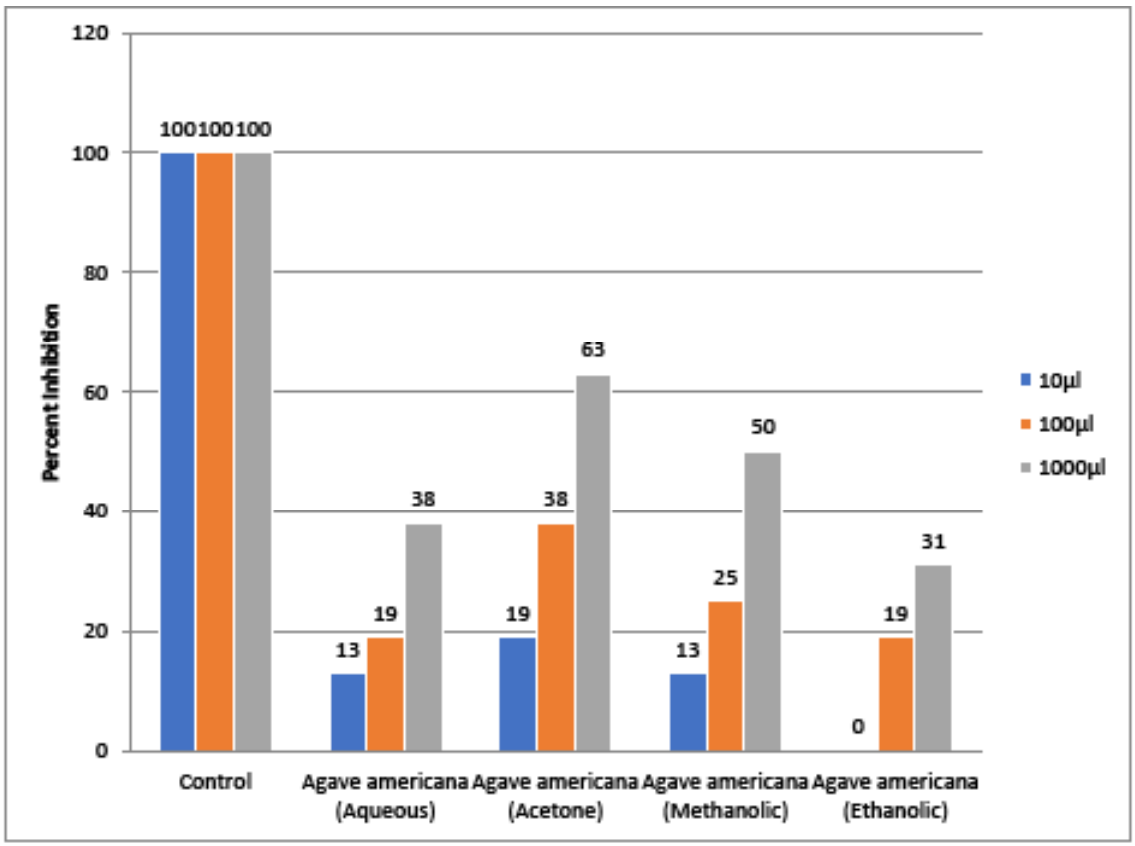

Figure 10. Percent phytotoxic activity of *Agave americana* extracts at variable concentrations

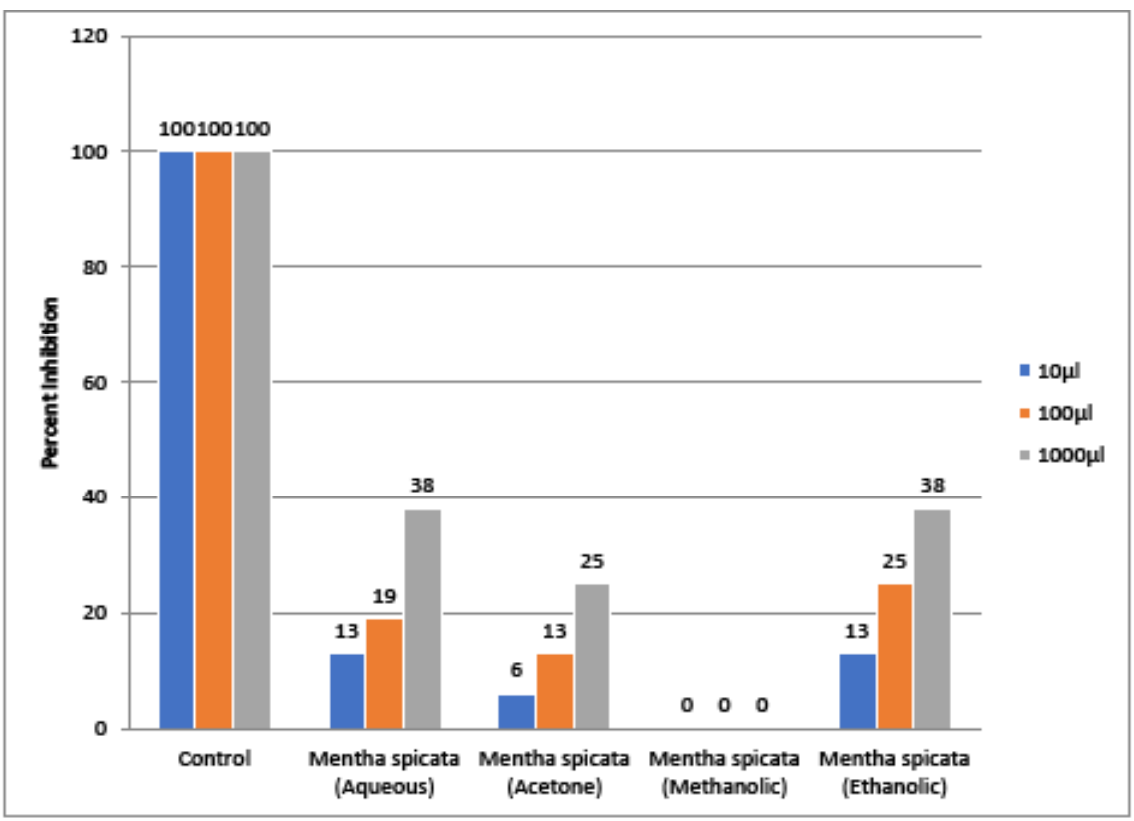

Figure 11. Percent phytotoxic activity of *Mentha spicata* extracts at variable concentrations

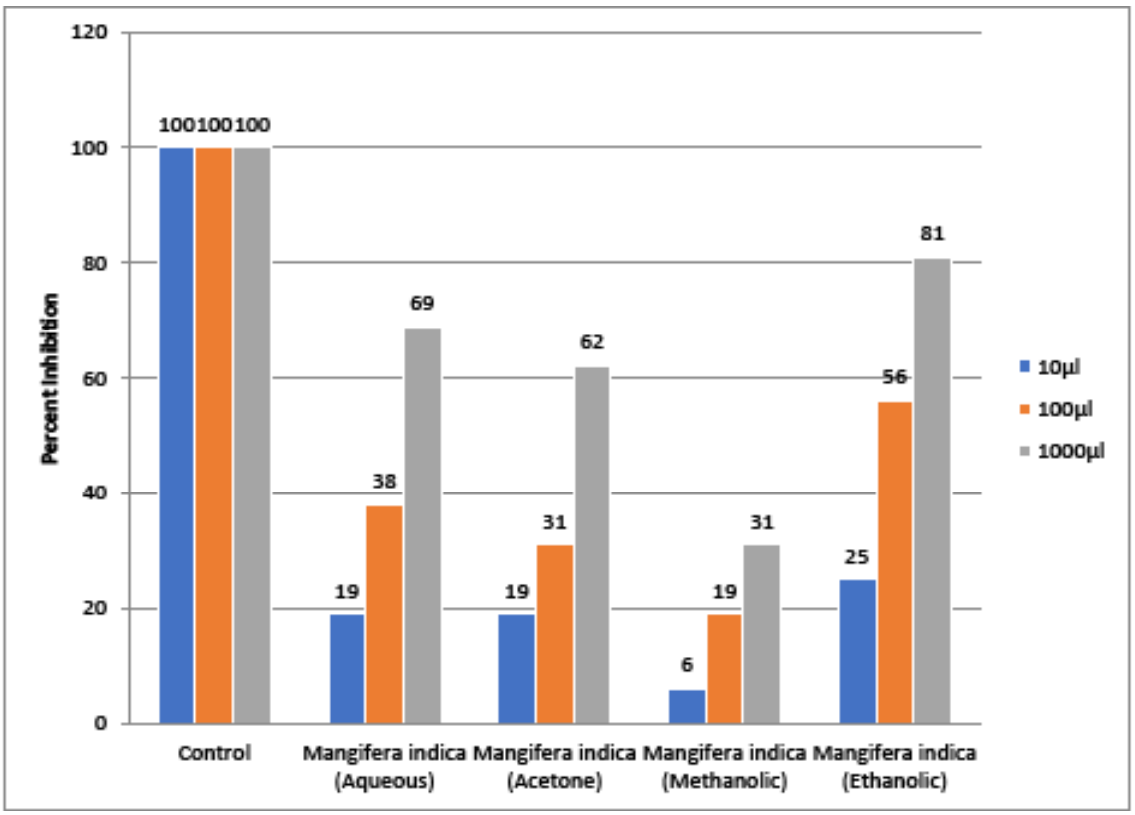

Figure 12. Percent phytotoxic activity of *Mangifera indica* extracts at variable concentrations

Haemagglutination Screening

Extracts from leaves of examined plants (*Agave americana, Mentha spicata, and Mangifera indica*) were screened for them for haemagglutination activity. Elucidated results were documented to be negative for all the extracts at different examined dilutions. Methanolic, ethanolic, aqueous, and acetone extracts from leaves of all three plants demonstrated no agglutination of red blood cells (RBCs) when tested against all the types of blood groups.

Conclusion

It could be concluded from outcome of current research exploration that crude leaves extracts of stipulated plants *i.e. Agave americana, Mentha spicata and Mangifera indica* possessed exceptional antibacterial prospects against all pathogenic test species and can be utilized to manufacture many antibacterial medicaments to control subsequent multi-resistant infective species accountable for nosocomial outbreaks. Pathogenic fungal species particularly *Fusarium oxysporum* mycelium were inhibited eminently and therefore may aid in elimination of Fusarium wilt, ultimately improving crop yields. Significant antioxidant and phytotoxic capacities observed in this study could be helpful in providing baseline data for many medicinal, cosmetic and food industries for the production of natural, non-toxic and eco-friendly products. Furthermore, negative haemagglutination activities were observed owing to the absence of *Phytoglutinins*.

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تقييم مضادات الميكروبات ومضادات الأكسدة والسمية النباتية لـ Mangifera Indica L. Extract، Mentha Spicata ،Agave Americana

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المُستَخلَص

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الهدف: تم تصميم الدراسة البحثية لتقييم الأنشطة الدوائية (مضادات الميكروبات، مضادات الأكسدة، سموم النباتات، التراص الدموي) لمستخلصات أوراق *Agave americana* و *Mentha spicata* و*Mangifera indica*. يمكن أن تساعد النتائج الإيجابية للدراسة في صياغة فرص علاجية جديدة باستخدام مواد خام طبيعية وصديقة للبيئة واقتصادية لها آثار جانبية أقل وفعالية عالية.

الطريقة: تم تحضير مستخلصات أوراق *Agave americana* و*Mentha spicata* و *Mangifera indica* باستخدام الإيثانول والميثانول والأسيتون والهيكسان التحليلي. ثم خضعت المستخلصات لمقايسة مضادة للجراثيم والفطريات ومضادات الأكسدة والسموم النباتية ومقايسة التراص الدموي. تم اتباع بروتوكول مضاد للجراثيم جيد الانتشار ضد البكتيريا المسببة للأمراض. تم اتباع بروتوكول مضاد للفطريات لتخفيف الأنبوب ضد الفطريات المسببة للأمراض. تم اتباع مقايسة الكسح الجذري DPPH بتخفيف عينة متغيرة لفحص مضادات الأكسدة. تم اتباع اختبار Lemna للفتك الطفيف لفحص السمية النباتية. تم تقييم مقايسة التراص الدموي ضد فصائل الدم ABO.

النتائج: تمتلك مستخلصات الأوراق الخام (المائية والأسيتون والميثانولية والإيثانولية) للنباتات المفضلة مثل *Agave americana* و*Mentha spicata* و*Mangifera indica* فعالية فائقة في مضادات الميكروبات ضد جميع الكائنات الحية الدقيقة المختبرة على وجه التحديد تم إيقاف *Pseudomonas aeroginosa* (85٪)، Escherichia coli (91٪)، المكورات العنقودية الذهبية المقاومة للميثيسيلين (81٪) و(85٪) mycelium of fusarium oxysporum بواسطة مستخلصات أوراق *Agave americana*. وبالمقارنة مع هذه المستخلصات الخام من *Mentha spicata*، أوقفت

بشكل كبير نمو (80٪) Proteus mirabilis بينما أوقفت مستخلصات أوراق *Mangifera indica* نمو بكتريا (90٪) *Streptococcus griseus* على التوالي، وسجلت فعالية ممتازة في مضادات الأكسدة والسموم النباتية عند التراكيز العالية للعينة ولم تسجل فعالية التراص الدموي.
الإستنتاج: استنتج من الدراسة أن أوراق *Agave americana* و*Mentha spicata* و*Mangifera indica* تمتلك إمكانات ممتازة في مضادات الميكروبات التي يمكن أن تساعد في صياغة مضادات حيوية جديدة لها تأثيرات ممتازة في الجرعات الأقل. يمكن أيضًا استخدام هذه المستخلصات لعلاج العديد من الأمراض عن طريق القضاء على المؤكسدات التفاعلية وتعزيز التمثيل الغذائي الصحي. يمكن أيضًا استخدام هذه المستخلصات كمبيدات أعشاب صديقة للبيئة وسهلة الاستخدام.

الكلمات المفتاحية: *Agave americana* و*Mentha spicata* و*Mangifera indica* والفحص البيولوجي.