SCREENING OF SOME MEDICINAL PLANTS FOR ANTIBACTERIAL ACTIVITY AGAINST CONJUNCTIVITIS

S. Meher[1], I. Ali[*2], A. Sami[3], M. Ismail[2], N. Naheed[4], S. A. Khan[5] and V. U. Ahmad[3]

[1]Department of Chemistry, Sardar Bahadur Khan Women's University, Brewery Road Quetta, Pakistan
[2]Department of Chemistry, Karakoram International University, 15100-Gilgit, Gilgit-Baltistan, Pakistan
[3]HEJ Research Institute of Chemistry, University of Karachi
[4]Department of Chemistry, Federal Urdu University of Science and Technology, Karachi, Pakistan
[5]Department of Chemistry, Faculty of Science, King Abdulaziz University, P.O. Box 80203, Jeddah-21589, Saudi Arabia
[*]Corresponding Authors. e-mail: iftikhar.ali@kiu.edu.pk

ABSTRACT

Antibiotic resistance is a persistently emerging problem all over the world. The constituents of therapeutic plant extracts play a key role in antimicrobialdrug discovery. Extracts of 36 medicinal plant species of Pakistan origin that belong to 33 genera and 24 families were tested against the bacterial strains *Staphylococcusaureus* and *Pseudomonas aeruginosa*. In addition the extracts of 23 plant species classified in 21 genera and 17 families were assessed against the bacterial clinical isolates (*S. aureus*, *P. aeruginosa*), using the agar well diffusion method. As a result, 10 plant extracts exhibiteddifferentproperties against the specific bacterial strains. Some plant extracts were also tested against the clinical *P. aeruginosa* and *S. aureus* isolates. Among the tested samples, Haleej, Anaar and Kali Mirch exhibited the highest relative percentage inhibition against *S. aureus* while Kala Zeera, Abhal and Khobani showed the highest inhibition against *P. aeruginosa*. In addition Anar exhibited the highest inhibition against the clinical *S. aureus* isolate whilePista followed by Zeera showed the highest inhibition against the clinical *P. aeruginosa* isolate.The results obtained in our present study might help explain the ethnobotanicalimportance of the screened plant species for the treatment of conjunctivitis.

Key words: Plant extracts−Antibacterial activity−Clinical isolates−Conjunctivitis.

INTRODUCTION

Conjunctivitis 'red eye'is aclinical problem (Mahmood and Narang, 2008) caused by infectious pathogens. Other causes of red eye include blepharitis, episcleritis, keratitis etc. (Du Toit and Van Zyl, 2013),while various allergic clinical conditions have been reported (Buckley, 1998).Effective management ofsuch common conditions might be achieved through a stepped care approach that starts with allergen-identification and antigenavoidance(Meyer, 2004).Sublingual immunotherapy has beenreported for the treatment of allergic conjunctivitis (Calderon *et al*., 2012).The inflammation of the conjunctiva, conjunctivitis in general, is due to various infectious and noninfectious agents. Red eyeis a form of bacterial conjunctivitis (Tarabishy and Jeng, 2008). Potentially complicated bacterial keratitis is the most visually threatening ocular infectious disease. Corneal perforations have been reported, *P. aeruginosa* and *S.aureus* being the invasive pathogens (Schaefer *et al*., 2001).

The therapeutic properties of plant species against bacterial infections have been investigated scientifically (Bhattarai *et al*., 2009).Due to the side effects exhibited by conventional medicines, natural products are a viablesource of alternative therapeutics (Ansari *et al*., 2006). Sharma and Singh (2002) reviewed the importance of a number of plant species belonging to 66 families to treat or cure conjunctivitis. Since ancient times, plant specieshave beenthe best source of medicine. Plants or plant-derived products have been used in traditional and folk therapeutic systemsto treata number of infectious diseases (Kumar *et al*., 2010). Many edible plants possess beneficial and therapeutic properties to humans, and plant extracts have been used as a source of alternative medication for their antioxidant, antifungal, and anticancer properties (Suwanmanee *et al*., 2014).

The present study is meantto determinethe major bacterial types causing conjunctivitis and to study theefficacyof36 plant species distributed in 33 genera and 24 families of Pakistan origin. Furthermore the methanolic andsome othersolvent extracts of 22 species distributed in 21 genera and 17 families were studied against the clinical isolatesof*S. aureus* and *P. aeruginosa*.

MATERIALS AND METHODS

Plant Material: All the plant species were collected during 2015 from Sindh province (Pakistan) with the help of the local practitioners and were authenticated by Dr.

Ghulam Rasool. The plant samples were dried in theshade and used for further work.

Preparation of Extracts: The plant materials were dried in theshade and powdered in a grinder. Each samplewas soaked in methanol and/or petroleum ether and chloroform for three days and then extracted in a Soxhlet apparatus separately. Each filtrate was concentrated separately and vacuumdried using arotary evaporator at 40 ^{0}C.

Test Microorganisms: Clinical isolates of *S. aureus* (Gram-positive) and *S. aeruginosa* (Gram-negative) were used in this study.The cultures were preserved on nutrient agar plates at a temperature of 4°C.

Antibacterial assay: Antibacterial activity of the crude plant extracts was studied by the well-known agar-well diffusion method (Jack *et al*., 1995; Tagg and Dajani, 1976). The testorganisms were inoculated into Mueller-Hinton broth (pH 7.4) and incubatedfor 8 hours. The concentration of the suspensionwas adjusted to optical density 0.5using aspectrophotometer. Sterilized cottonswabs were used to seed the isolates onto the Mueller-Hinton agar plates. A sterilized gel borer was used to bore theagar surface to make wells of 6mm diameter. One hundred µL of the test samples and 100µL of 10% DMSO (negative control) were poured into the separate wells. The standard antibiotic disc (Imipenem 10µg/disc)was placed on the agar surface as positive control. Plates were incubated at 37°C for 48 hours. Triplicate plates were used for each organism.

Determination of Relative percentage Inhibition: The relative percentage inhibition of the test samples was calculated usingthe followingformula with respect to positive control (Ajay *et al*., 2003; Kumar *et al*., 2010).

$$\text{Relative percentage inhibition of the test extract} = \frac{100 \times (x-y)}{(z-y)}$$

Where x: total area of inhibition of the test sample
y: total area of inhibition of the solvent
z: total area of inhibition of the standard drug
The total area of inhibition was calculated usingarea = πr^2; where, r = radius of zone of inhibition.

RESULTS

The results of the antibacterial testing of the samples against the bacterial strains *S. aureus* and *P. aeruginosa* are presented in table 1. Among the 36 plant species, 15 extracts exhibited inhibition against *S. aureus* and 20 extracts exhibited inhibition against *P. aeruginosa*. The maximum relative percentage inhibition was exhibited by the methanolic extract of fruit part of Haleej (*Terminaliachebula* Retz.) against *S. aureus* followed by the methanolic extracts of the fruit parts of Anaar (*Punicagranatum* L.), Kali Mirch (*Piper nigrum* L.), Kala Zeera (*Buniumbulbocastanum* L.), and the methanolic extract of flower part of Gul e Surkh (*Rosa damascena* Mill.), etc. and the lowest percentage inhibition was manifested by the methanolic extract of the whole plant of Bildi (*Ipomoea hederacea* Jacq.) against the *S. aureus*, while the methanolic extracts of22 plant species did not exhibit any inhibition against *S. aureus*. Moreover, the maximum percentage inhibition against *P. aeruginosa* was exhibited by the methanolic extracts of Kala Zeera (fruit part), Abhal (seeds) and Khobani (fruit part) etc. The lowestpercentage inhibition against *P. aeruginosa* was shown by the methanolic fruit extract of Sufaid Zeera and the methanolic flower extract of Kasini. Seventeen plant species did not show any inhibition against *P. aeruginosa*. Mostly the methanolic extracts of thefruit part of the plant species exhibited the inhibition, followed by the flower part. The root part of Ratanjot, Balcharr and Haldi did not exhibit any inhibition against none of the bacterial strains.

Table 1. Inhibition zone (mm) of different plant extracts against microorganisms

Family	Botanical Name	Local Name	Part Used*	*S.aureus*	*P.aeruginosa*
Acanthaceae	*Adhatodavasica*Nees	Adusa, Bansa	Leaves	-	-
Agaricaceae	*Agaricusbisporus*Lange.	Botton Mushroom	Fruit	-	-
Apiaceae	*Buniumbulbocastanum*L.	Kala Zeera	Fruit	12	15
	Centellaasiatica(L.) Urb.	Brahmi	Leaves	-	-
	Cuminumcyminum L.	SufaidZeera	Fruit	-	8
	*Daucuscarota*L.	Gajar	Fruit	-	-
Asteraceae	*Cichoriumintybus* L.	Kasini	Flower	9	8
Boraginaceae	*Onosmaechioides*(L.) L.	Ratanjot	Root	-	-
Caprifoliaceae	*Nardostachysjatamansi*(D. Don) DC.	Balcharr	Root	-	-
Combretaceae	*Terminaliachebula* Retz.	Haleej	Fruit	18	13
Convolvulaceae	*Ipomoea hederacea*Jacq.	Bildi	Whole plant	7	10
Cupressaceae	*Juniperuscommunis*L.	Abhal	Seeds	-	15
Fabaceae	*Acacia nilotica* (L.) Willd. ex Delile	Sindhi Keekar	Leaves	-	10

	Acacia nilotica (L.) Willd. ex Delile	Sindhi Keekar	Seeds	-	14
Iridaceae	*Iris germanica*L.	Airsa, Irsa	Leaves	-	13
Lamiaceae	*Lavandulastoechas* L.	Ustkhuddus	Ground part	10	9
	*Origanummajorana*L.	Marzanjosh	Leaves	-	-
Linaceae	*Linumusitatissimum* L.	Alsi	Seeds	10	9
Lythraceae	*Punicagranatum* L.	Anaar	Fruit coat	15	10
Malvaceae	*Hibiscus rosa-sinensis* L.	Gul e Gurhal	Flower	-	-
	*Myrtuscommunis*L.	Barg e Maurid	Leaves	-	-
	Syzygiumaromaticum(L.) Merr. & L.M. Perry	Loang	Fruit	10	11
Piperaceae	*Piper nigrum* L.	Kali Mirch	Fruit	13	9
Primulaceae	*Embeliarobusta* Roxb.	Baobaranj, Wavarang	Bark	10	12
Pteridaceae	*Adiantumcapillus-veneris*L.	Hansraj	Leaves	9	-
Ranunculaceae	*Nigella sativa* L.	Kalonji	Seeds	-	-
Rosaceae	*Prunusarmeniaca*L.	Khobani	Fruit	11	15
	Prunuscerasus L.	SurkhPhal	Fruit	-	-
	*Prunusdomestica*L.	Aalu Bukhara	Fruit	-	-
	Rosadamascena Mill	Gul e Surkh	Flower	12	13
Rutaceae	*Aeglemarmelos*(L.) Corrêa	BelGiri	Fruit	9	9
Solanaceae	*Physalisalkekengi*L.	Kaknaj	Leaves	-	-
	Physalis minima L.	Rasbhari	Fruit	-	-
	*Solanumforskalii*Dunal.		Whole plant	-	-
	Withaniacoagulans (Stocks) Dunal	PaneerDoda	Seeds and Fruit	-	9
Violaceae	*Viola odorata*L.	Gul e Banafsha	Flower	9	9
Zingiberaceae	*Curcuma longa* L.	Haldi	Root	-	-

* All samples were extracted in methanol.

The results of the antibacterial testsof certain plant samplesin our present study against the clinical isolates are presented in table 2.Among the 23 plant species, only 9 plant species exhibited inhibition of the clinical bacterial isolate *S. aureus*. The highestinhibition was shown by the petroleum ether extract of Anaar (15%) followed by the chloroform extract of Gul e Surkh and methanolic extract of Jhao(13% each). Moreover,12% inhibition against the clinical isolate (*S. aureus*) was observed by the methanolic extracts of Zeeraand Pista. The petroleum etherextract of Gul e Surkh andmethanolic extract of Haleejexhibited 11% inhibition each, followed by themethanolic extract of Anjeer (10%) and the chloroform extract *of* Anaar (7%) exhibited the minimum inhibition against the clinical bacterial isolate, *S. aureus*. The remaining 16 plant species did not exhibit any inhibition against the clinical isolate, *S. aureus*.

Furthermore, 8 plant species exhibited antagonism against the clinical *P. aeruginosa* isolate while the remaining 17 plant extracts did not show inhibition of the clinical isolate*P. aeruginosa*. The highest inhibition was shown by the methanolic extract of Pista(20%), followed by Zeera(MeOH, 15%), Gul e Surkh ($CHCl_3$) and Jhao(MeOH, 12% each), Haleej (MeOH, 11%), Anaar (PE, 10%) and Anjeer(MeOH, 9%). The lowest inhibition was shown by the $CHCl_3$ extract of Anaar (8%) against the clinical isolate of *P. aeruginosa*.

Table 2. Inhibition zone (mm) of different plant extracts against clinical isolates

Family	Botanical Name	Local Name	Part Used	Extractive	*S. aureus*	*P. aeruginosa*
Anacardiaceae	*Mangiferaindica* L.	Aam	Fruit	MeOH	-	-
	*Pistaciavera*L.	Pista	Fruit	MeOH	12	20
Apiaceae	*Carumcarvi* L.	Zeera	Fruit or Seeds	MeOH	12	15
	Coriandrumsativum L.	Dhaniyaa	Seeds	MeOH	-	-
Combretaceae	*Terminaliachebula* Retz.	Haleej	Fruit	MeOH	11	11
Cucurbitaceae	*Citrulluscolocynthis* (L.) Schrad.	Indrayan	Fruit	MeOH	-	-

Lauraceae	*Cinnamomumtamala* (Buch.-Ham.) T. Nees&Nees	Tezpat	Leaves	MeOH	-	-
	*Cinnamomumzeylanicum*Blume	Dar chini	Fruit	MeOH	-	-
	*Punicagranatum*L.	Anaar	Fruit coat	PE	15	10
	*Punicagranatum*L.	Anaar	Fruit coat	$CHCl_3$	7	8
Moraceae	*Ficuscarica* L.	Anjeer		MeOH	10	9
Papaveraceae	*Papaversomniferum*L.	Khashkhash	Seeds	MeOH	-	-
Parmeliaceae	*Usnealongissima* Ach.	-	Aerial part	MeOH	-	-
Polygonaceae	*Polygonumbistorta* L.	Anjbar	Flowers	MeOH	-	-
	Rheum emodi Wall.	Rewandchini		MeOH	-	-
Primulaceae	*EmbeliarobustaRoxb.*	Baobaranj	Bark	MeOH	-	-
Rosaceae	*Prunusarmeniaca*L.	Khobani	Fruit	MeOH	-	-
	*Rosadamascena*Mill.	Gul e Surkh	Flower	$CHCl_3$	13	12
	*Rosadamascena*Mill.	Gul e Surkh	Flower	PE	11	-
Rubiaceae	*Rubiacordifolia*L.	Majith	Root	MeOH	-	-
Santalaceae	*Santalum album* L.	Sandal Safaid	Fruit	MeOH	-	-
Solanaceae	*Daturastramonium* L.	Kala datura	Seeds	MeOH	-	
Tamaricaceae	*Tamarixdioica*Roxb. ex Roth	Jhao	Leaves and flowers	MeOH	13	12
Violaceae	*Viola odorata*L.	Gul e Banafsha	Flower	MeOH	-	-
Vitaceae	*Vitisvinifera* L.	Kishmish	Fruit	MeOH	-	-

Table 3. Diameter of Zone of Inhibition (mm) of Standard Drug

Name of Organism	Zone of inhibition (Imipenem 10µg/disc)
S. aureus	43
P. aeruginosa	32

Comparing the results with standard antibiotic i.e.Imipenem, the inhibitory effect of thedrug against *S.aureus* was about43 mm andagainst *P. aeruginosa*32 mm (table 3).

DISCUSSION

Natural products are aprime source of antimicrobials. Many efforts have been done to identify compounds that serve as appropriate antimicrobial agents (Ramalivhana *et. al*., 2013). For the production of less toxic and more effective antibiotics, plant products i.e. phyto-chemicals are the eminent resource. The above-mentioned plant extracts showed significant or moderate activities against resistant clinical isolatesof*S. aureus* and *P. aeruginosa*. Theseplant extracts possess great potential as antimicrobials. Furthermore, these plant species can be employedto treat and/or cure infectious diseases like conjunctivitis,usually caused by resistant pathogens. The highestrelative percentage inhibition was shown by Haleej against *S. aureus* followed by Anaar. Hogade *et al*. (2011) evaluated the aqueous fruit extract of Haleej against Gram-positive bacteria (e.g.*S.aureus*) and Gram-negative bacteria (e.g. *P. aeruginosa*)by pourplate method ina sterile nutrient agar medium plate. However, in our present study, the methanolic fruit extract of Haleej showed lower activity against *S. aureus* and *P. aeruginosa* compared to the reported results by the aqueous fruit extract. Similarly, antibacterial screening of the ethanolic fruit extract of Haleejwas carried out using the standard disc diffusion test. However, thehighestactivity was exhibited against *Salmonellatyphi*, *Staphylococcusepidermidis* and *Bacillus subtilis* (Kannan*et al*., 2009).Similarly, a number of reports are available regarding the antimicrobial properties of different varieties of Anaar (Betanzos-Cabrera *et al*., 2015; Jasim*et al*., 2014; Kadi*et al*., 2011).

Moreover, the maximum percentage inhibition against *P. aeruginosa* was exhibited by the extracts of Kala Zeera, Abhal and Khobani, followed by Sindhi Keekar. The maximum inhibition was shown by the petroleum ether extract of Anaar followed by the chloroform extract of Gul e Surkh and themethanolic extract of Jhaoagainst the clinical isolate of*S. aureus*. However, the methanolic extract of Pista showed the highestinhibition against the clinical *P. aeruginosa*isolate, followed by Zeera, Gul e Surkhand Jhaoplant extracts.

According to Khan *et al*. (2013), Kala Zeera (*Buniumbulbocastanum*) was screened for various biological activities and the crude methanolic extract exhibited significant activity against *S. aureus*. However, the Et OAc fraction was inactive against *P.aeroginosa* and *S.aureus* while the aqueous extract exhibited moderate action against *S. aureus* and *E.coli*,but it exhibited low activity against *P.aerogenosa*. Similarly, the antimicrobial properties of Abhal (*J. communis* L.) have been reported(Hazir*iet al*., 2013; Sati and Joshi, 2010; Rezvani *et al*., 2009). The essential oil of Abhalexhibited activity against *S. aureus* while not against *P. aeroginosa* (Haziri *et al*., 2013).In a related study Sati and Joshi (2010) reported that the hexane extract of leaves of Abhal showed maximum activity followed by ethanolic, methanolic and chloroform extracts; however, the aqueous extract did not show any activity against any tested organism. Moreover, the essential oil exhibited notable antibacterial activity against *S. aureus* and *P. aeroginosa* (Rezvani*et al*., 2009).In addition, the reports about the antimicrobial evaluation of Khobani revealed its potential against various organisms including *S. aureus* and *P. aeroginosa* (Sharma *et al*., 2014; Gomaa, 2013).Similarly, the antibacterial properties of Sindhi Keekar (*Acacia nilotica*) have been determined against various bacteria (Abdallah, 2016; Amjad-ur-Rahman *et al*., 2014). Furthermore, Banso (2009) found that the bark extract of Sindhi Keekar was active against *Streptococcusviridans*, *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli*and *Shigellasonnei*. However, Deshpande (2013) found that theethanol extract of Sindhi Keekar exhibited better antibacterial activity against the clinical *S. aureus* isolateas compared to the petroleum ether extract and Nagumanthri *et al*. (2012) reported that ethanolic leave and bark extracts of Sindhi Keekar showed activity against the clinical *S. aureus* isolate. Khan *et al*. (2013) reported the antimicrobial potential of Jhaoagainst *S. aureus* and *P. aeroginosa*. The results of the present study agree with the previously reported investigation. While the plant species including *M. indica*, *C.sativum*, *C.colocynthis*, *C.tamala*, *C.zeylanicum*, *P.somniferum*, *U.longissima*, *P.bistorta*, *R.emodi*, *E.robusta*, *P. armeniaca*, *R.cordifolia*, *S. album*, *D.stramonium*, *V.odorata* and *V.vinifera* did not exhibit any activity against the tested clinical isolates, themedicinal plant speciescovered in the present studythat exhibited activity against the clinical isolates could be further investigated forthe discovery of bioactive natural products.

Conclusions: Among the36 medicinal plant extractsstudied, the highest relative percentage inhibition was exhibited by Haleej (18%) followed by Anaar (15%) and Kali Mirch (13%) against *S. aureus*while the methanolicextracts of Kala Zeera, Abhal and Khobani (15 % each) manifested the highest inhibition against *P. aeruginosa*. Moreover, maximum inhibition was shown by the petroleum ether extract of Anaar (15%) followed by the chloroform extract of flower part ofGul e Surkh(13%) against the clinical *S. aureus*isolate. Moreover, 12% inhibition against the clinical isolate of *S. aureus* was shown by the methanolic extracts of Zeera and Pista. Furthermore, 8 plant extracts exhibited antagonism against the clinical *P. aeruginosa*isolate. However the maximum inhibition was shown by the methanolicextracts of fruit part ofPista (20%) followed by the fruit and seeds part ofZeera(15%) against the clinical *P. aeruginosa* isolate. The antimicrobial potential of these plant species extracts suggest for their use as alternative therapeutic agents against conjunctivitis. Further insightful research should be carried out to understand its efficacy because it can be used as a potential source for the development of a phyto-medicine to treat or cure conjunctivitis. The development of modern drugs in the form of phyto-medicine from the most active plant extracts should be emphasized for the treatment of conjunctivitis.

Acknowledgements: The authors thank Higher Education Commission of Pakistan for the financial assistance and traditional practitioners for their help and willingness to share the indigenous knowledge on traditional medicines.

REFERENCES

Abdallah E.M. (2016). Antibacterial efficacy of *Acacia nilotica* (L.) pods growing in Sudan against some bacterial pathogens. Int. J. Curr. Res. Biosci. Plant Biol., 3(3): 6-11.

Ajay K.K., R.M.K. Lokanatha and K.B. Umesha (2003). Evaluation of antibacterial activity of 3,5-dicyano-4,6-diaryl-4-ethoxycarbonyl-piperid-2-ones. J. Pharmaceut. Biomed. An., 27: 837-840.

Amjad-ur-Rahman, A. Shakoor, G. Zaib, A.S. Mumtaz, Y. Ihtesham and A.A. Napar (2014). Comparative antimicrobial activity of *Acacia nilotica* L. leaves extracts against pathogenic bacteria and fungi. J. Med. Pl. Res., 8(29): 975-982.

Ansari M.M., S.A.Khan, J. Ahmad and S.H. Ansari (2006). Pharmacognostical studies on the bark of *Alstoniascholaris* R. Br. (Chatiun). Hamdard Med., 49: 95-103.

Banso A. (2009). Phytochemical and antibacterial investigation of bark extracts of *Acacia nilotica*. J. Med. Pl. Res., 3(2): 82-85.

Betanzos-Cabrera G., P.Y. Montes-Rubio, H.E. Fabela-Illescas, H. Belefant-Miller and J.C. Cancino-Diaz (2015). Antibacterial activity of fresh pomegranate juice against clinical strains of *Staphylococcus epidermidis*. Food & Nutrition Research, 59: 27620.

Bhattarai S., R.P. Chaudhary, R.S.L. Taylor and S.K. Ghimire (2009). Biological activities of some Nepalese medicinal plants used in treating bacterial infections in human beings. Nepal J. Sc. Tech., 10: 83-90.

Buckley R.J. Allergic eye disease – a clinical challenge (1998).Clin. Exp. Aller., 28(6): 39-43.

Calderon M.A., M. Penagos, A. Sheikh, G.W. Canonica and S.Durham (2012). Sublingual immunotherapy for treating allergic conjunctivitis (Review). Evidence-based Ch. Health: A Cochrane Rev. J., 7(3): 1041-1154.

Deshpande S.N. (2013). Preliminary phytochemical analysis and in vitro investigation of antibacterial activity of *Acacia nilotica* against clinical isolates. J. Pharmacog. Phytochem., 1(3): 23-27.

Du Toit N. and L. Van Zyl (2013).The red eye. SA Fam. Pract., 55: 33-40.

Gomaa E.Z. (2013). In vitro antioxidant, antimicrobial, and antitumor activities of bitter almond and sweet apricot (*Prunusarmeniaca* L.) kernels. Food Sci. Biotechnol., 22(2): 455-463.

Haziri A., F. Faiku, A. Mehmeti, S. Govori, S. Abazi, M. Daci, I. Haziri, A.Bytyqi-Damoni and A. Mele (2013). Antimicrobial properties of the essential oil of *Juniperuscommunis* (L.) growing wild in East part of Kosovo. Am. J. Pharmacol. Toxicol., 8(3): 128-133.

Hogade M.G., S. Jalalpure and S.Kuthar (2011). Antibacterial activity of fruit extract of *Terminaliachebula* Retz. against some Gram positive and Gram negative bacteria. Int. J. Pharm. Pharmaceut. Sc. Res., 1(1): 26-29.

Jack R.W., J.R. Tagg and B.Ray (1995). Bacteriocins of gram-positive bacteria. Microbiol. Rev., 59(2): 171-200.

Jasim A.S., A.T. Abdul-wahid, L.A.A. Gabar and B.K. Yussif (2014).Evaluation of antimicrobial activity of phenolic extract from *Punicagranatum* L. peel.Bas. J. Vet. Res. 1(1): 26-32.

Kadi H., A. Moussaoui, H. Benmehdi, H.A. Lazouni, A. Benayahia and N.N. Bouderba (2011). Antibacterial activity of ethanolic and aqueous extracts of *Punicagranatum* L. bark. J. Appl. Pharmaceut. Sc., 1(10): 180-182.

Kannan P., S.R.Ramadevi and H.Waheeta (2009). Antibacterial activity of *Terminaliachebula* fruit extract. Afr. J. Microbiol. Res. 3(4): 180-184.

Khan I., H. Ahmad, N. Ali, B. Ahmad and H.Tanoli (2013).Screening of *Buniumbulbocastanum* for antibacterial, antifungal, phytotoxic and haemagglutination activities. Pak. J. Pharm. Sci., 26(4): 787-791.

Khan S., F. Ullah and T. Mahmood (2013).In vitro antimicrobial and cytotoxic activity of *Tamarixdioica* Roxb. leaves. Turk. J. Biol., 37: 329-335.

Kumar G., L. Karthik and K.V.B. Rao (2010), In vitro anti-candida activity of *Calotropisgigantea* against clinical isolates of Candida. J. Pharm. Res., 3: 539-542.

Kumar G., L. Karthik and K.V.B. Rao (2010). Antimicrobial activity of latex of *Calotropisgigantea* against pathogenic microorganisms - an in vitro study. Pharmacologyonline, 3: 155-163.

Mahmood A.R. and A.T. Narang (2008).Diagnosis and management of the acute red eye. Emerg. Med. Clin. N. Am., 26(1): 35-55.

Meyer D. (2004). A step-care approach to the management of seasonal allergic conjunctivitis. SA Fam. Pract., 46(7): 45-46.

Nagumanthri V., S. Rahiman, B.A. Tantry, P. Nissankararao and M.P. Kumar (2012). In vitro Antimicrobial activity of *Acacia nilotica*, *Ziziphusmauritiana*, *Bauhinia variegate* and *Lantana camara* against some clinical isolated strains. Iranian J. Sc. Technol., A2: 213-217.

Rezvani S., M.A. Rezai and N. Mahmoodi (2009). Analysis and antimicrobial activity of the plant *Juniperuscommunis*. Rasayan J. Chem., 2(2): 657-260.

Sati S.C. and S.Joshi (2010). Antibacterial potential of leaf extracts of *Juniperuscommunis* L. from Kumaun Himalaya. Afr. J. Microbiol. Res., 4(12): 1291-1294.

Schaefer F, Bruttin O, Zografos L and Guex-Crosier Y (2001). Bacterial keratitis: a prospective clinical and microbiological study. Br. J. Ophthalmol., 85(7): 842-7.

Sharma P. and G.Singh (2002). A review of plant species used to treat conjunctivitis. Phytoth. Res., 16: 1-22.

Sharma S., G. Satpathy and R.K. Gupta (2014). Nutritional, phytochemical, antioxidant and antimicrobial activity of *Prunusarmenicus*. J. Pharmacog. Phytochem., 3(3): 23-28.

Suwanmanee S., T. Kitisin and N. Luplertlop (2014).In vitro screening of 10 edible Thai plants for potential antifungal properties. Evidence-Based Compl. Alt. Med., 2014, Article ID 138587, 7 pages.

Tagg J.R., A.S. Dajani and L.W. Wannamaker (1976). Bacteriocins of gram-positive bacteria. Bacteriol. Rev., 40(3): 722-756.

Tarabishy A.B. and B.H. Jeng (2008). Bacterial conjunctivitis: a review for internists. Cleve. Clin. J. Med., 75(7): 507-12.