



Overview on Phytochemical and Biological Properties of Plant Extract

Mr. Kiran B. Patil

Department of Science and Humanities,
KCES COEM, Jalgaon-425001, Maharashtra, India

Dr. Mrs. Madhuri S. Patil

Department of Chemistry,
J.D.M.V.P. Samaj's,

Shri. S. S. Patil Art's, Shri. Bhausaheb T. T. Salunkhe Commerce
and Shri. G. R. Pandit Science College, Jalgaon-425001,
Maharashtra, India

Abstract:

The part of plant stem, leaves, flowers, bark, tumors and seed extracts is applicable in curing the various diseases by analysis the phytochemical and biological activities. The plant extracts in different solvents shows the anti-microbial, anti-bacterial, anti-inflammatory, anti-cancer, anti-fungal, and anti-oxidants activities. The plant extracts like *Colocasia esculenta*, *Shrea Robusta*, *A.aspera*, *Morinda lucida*, *Vernonica amygdalina* having the disease curing capability. The analysis of phytochemical having presence of flavonoids, tannins, saponins, alkaloids, and amino acids. Analysis of plant extract is also used in silver, gold, zinc nano partical synthesis and shows biological activities.

Keywords: plant extracts; phytochemical analysis; biological activity; Medicinal uses.

Introduction

The plant based medicines is used since ages for curing various ailments and phytochemical analysis to detect various important compounds [3]. The medicinal values lie in bioactive phytochemical constituents that produce definite physiological action on the human body [5]. The part of plant like leaves, roots, flowers, tumors and bark are used for the extraction [12, 13, 15]. Different plant extracts presence of flavonoids, tannins, saponins, alkaloids, amino acids [26]. The thousands of plant extracts can be used for bioactivity and phytochemical analysis [8] such as anti-inflammatory, anti-allergic anti-microbial, anti-viral, anti-cancer, anti-fungal, antioxidant, cardio protective and vasodilator activities [7, 8, 9, 11, 16, 19].

Plants have played important roles in sustaining, improving quality of human health and have served humans as beneficial components of medicines. Seasoning beverage, cosmetics and dyes due to this fact the focus on plant research has increased all over the world. Medicinal plants have less or no side effects affordable and radially available to the community [18]. The tuber of *Colocasia esculenta* having bioactive constituents for development of new chemotherapeutic agent [2]. Extract of *Shrea Robusta* resin have stronger and boarder spectrum of pathogenic microorganisms [3]. Leaves, roots, stem and bark of *Morinda lucida* are widely used in tropical Africa due to reputed therapeutic values in the treatment of anti- inflammatory and anti-parasitic disease [4,20]. The *A.aspera* extracts possess numerous secondary metabolites including ferulic acid, apigenin and salicylic acid with pharmacological application [5]. *Vernonica amygdalina* is commonly bitter leaf due to bitter taste it reported to be for diabetes and fever [4, 10]. The species of *Vernonia* all have effective on blood purification, uterus toner and the prevention of atherosclerosis [4,12,17]. The silver nano particle synthesis was successfully carried out by *Phyllanthus emblica* plant extract as reducing agent and aqueous silver nitrate. The green, rapid, facile, cost-effective, eco friendly synthesis and synthesized nanoparticles also investigate their antibacterial activity [20]. Biodiversity studies revolved that the plant kingdom has been exhausted based on the species of medicinal plants which are yet to be discovered. Use of the plants extract is not just a custom of the distant past world's population still relies completely on raw herbs and unrefined extracts as medicines.

Large numbers of works done on medicinal plants which have been extracted and compounds isolated successfully. Compound tested for biological and pharmacological activities found to be active. The plant extracts having the tremendous capacity to cure the number of diseases. Traditionally the extract used as medicine in various countries. Extract of plant is applicable in the pharmacological activities. The all part of the plant is used as the medicinal drugs. The history of the Indian Ayurveda is based on plant extract. The Tea is common morning drinks in various countries and acts as refresher of human body and is prepared by boiling the special plant leaves [40]. The tuber of *Colocasia esculenta* having bioactive constituents for development of new chemotherapeutic agent [2]. Extract of *Shrea Robusta* resin have stronger and boarder spectrum of pathogenic microorganisms [3]. Leaves, roots, stem and bark of *Morinda lucida* are widely used in tropical Africa due to reputed therapeutic values in the treatment of anti- inflammatory and anti-parasitic disease [4, 20]. *A. aspera* extracts possess numerous secondary metabolites including ferulic acid, apigenin and salicylic acid with pharmacological application [5]. *Vernonica amygdalina* is commonly bitter leaf due to bitter taste it reported to be for diabetes and fever [4, 10]. Species of *Vernonia* all have effective on blood purification, uterus toner and the prevention of atherosclerosis [5, 12, 17].

Research Background

Antimicrobial activities of plant leaves, flowers, stems, roots, or fruits from various herbs and spices have been reported by many researchers successful prediction of botanical compounds from plant material is largely dependent on the various types of solvent used in the extraction. Different literature shows that, antifungal activity of *Annona squamosa* Linn. against *Alternaria alternate*, antifungal activity of *A. squamosa* against *Candida albicans*, antifungal activity of *A. squamosa* against *Fusarium Solani*, antifungal activity of *A. squamosa* against *Microsporium Canis*, antifungal activity of *A. squamosa* against *Aspergillus Niger*, antifungal assay carried out with aqueous and organic extracts of *A. squamosa* leaves showed their inhibitory properties. The chloroform, methanol, and aqueous extracts of the leaves of *A. squamosa* have in vitro antifungal



and antioxidant activities [1].

Colocasia esculenta tubers contain moisture, ash, carbohydrate, protein, and starch, it contains high nutritive value. In this finding's tubers of Colocasia esculenta contain various chemical components such as alkaloids, glycosides, terpenoids, flavonoids, saponins and phenols in methanolic extract. Similar result was reported by [21] except in the case of saponins. The plant species could use alkaloids to protect themselves against herbivores, because the lifestyle of plants is unable to avoid their predators. They could also be used as a origin of insecticides and fungicides. Researchers also revealed that alkaloids help biologically in storage of waste nitrogen, cationic balancing and protection against parasites [22]. Alkaloids are used for reducing headache and fever in medicine. These are attributed for antibacterial and analgesic properties [23]. The terpenoids represent a diverse class of molecules that are related to therapeutic properties including anti-cancer, anti-parasitic, anti-microbial, anti-allergic, anti-spasmodic, anti-hyperglycemic, anti-inflammatory and immune modulator properties [24, 25, 26]. Phenolic compound having antioxidant activity base in consumable material of Araceae family and are take in food manufactures as consumers moves to useful foods with certain health effects. The phenolic compounds are the most important antioxidants of plant materials and it constitutes one of the major groups of compounds acting as primary antioxidants or few radical terminators. The glycosides are naturally cardio active drugs used in the treatment of congestive heart failure and cardiac arrhythmia [27]. The presence of glycosides indicates that they may be potent in curing cardiac insufficiency, coughs and circulatory problems also; they may act as good sedatives and have antispasmodic properties [28]. The flavonoids are group of poly phenolic compounds which influence the radical scavenging, inhibition, of hydrolytic and oxidative enzymes and act as anti-inflammatory agent [29]. The biological functions of flavonoids apart from its antioxidant properties include protection against aggregation, microbes, ulcers, hepa toxins, viruses, and tumors [30]. The saponins were found in Colocasia esculenta tubers shows natural tendency for treating fungal and yeast infections.

The extracts could be responsible for the antibacterial activity and triterpenoids have astringent actions, which form the basis for their therapeutic applications [31]. It was found that the plants which contain triterpenoids had antimicrobial activity [32]. The results of antimicrobial activity are comparable with the results of the previous research using extracts of other species like Azadirachta indica [33], Chukrasia tabularis [34], Toona ciliata and Amooraro hituka [35], Aglaia spectabilis [36], Walsura trifoliata [37]. The effectiveness may be due to the cumulative action of different compounds present in the plant parts [38]. The evidence shows the promising therapeutic potential, especially in the case of herb products against viral infections.

The synthesis of AgNPs was eco friendly, easy approach and use the phyllanthus emblica plant extracts which act as a reducing, stabilizing, and capping agent for nanoparticle synthesis. This is a simple, green efficient method for the synthesis of silver nano particles at room temperature without using any harmful reducing and capping agent. The green synthesized silver nanoparticles were pile up spherical shape which was reliable and crystalline. These AgNPs were mark by XRD, TEM, FTIR, PL, and UV-visible spectroscopy. The antibacterial activity of AgNPs analyzed against E. Coli bacteria and the outcome shows that a high concentration of AgNPs is enlarge as well as the zone of inhibition grow. This synthesizes process is inexpensive, a single step, and speedy as compared to chemical and biological methods as well as non-polluting, of affordable, and easy therefore can assist the application of the green method for silver nanoparticles synthesis [20].

Materials and methods

Preparation of extract

Collect the Leaves, Flowers, Fruit, Stem, Bark and Tumors. The material is air dried under shade at room temperature. After comminuting the plant material into powder and extraction using solvents. 10 g of dried powder material was soaked separately in beakers, each containing 40 mL of extraction solvents of ranging polarity from highly non-polar to highly polar solvents including n-hexane (n-Hex), Chloroform (CHCl₃), Acetone (Ace), Ethyl acetate (EtOAc), Ethanol (EtOH), Methanol (MeOH). Along with individual solvents, combinations of solvents at 1:1 were also used as follow: EtOH+CHCl₃, MeOH+CHCl₃, Ace+EtOAc, EtOH+EtOAc, and MeOH+EtOAc. The plant material was soaked for 48 h, thereafter filtered through Whatman No.1 filter paper. The residue was again dipped in respective solvent/s and this process was repeated thrice. The respective extracts is combined and concentrated by evaporating the solvent under reduced pressure in a rotary evaporator at 45°C [9].

Quantitative determination of phytochemical analysis as following

Chemical test is carried out on the aqueous extract and on the powdered specimen using standard procedure to identify the constituents [10, 14].

Test for flavonoids

1 g of the powdered dried leaves of each specimen was boiled with 10 ml of distilled water for 5 minutes and filtered while hot. Few drops of 20 % sodium hydroxide solution were added to 1 ml of the cooled filtrate. A change to yellow colour which on addition of acid changed to colorless solution depicted the presence of flavonoids.

Test for tannins

1 g of each powdered sample was separately boiled with 20 ml distilled water for five minutes in a water bath and was filtered while hot 1 ml of cool filtrate was distilled to 5 ml with distilled water and a few drops (2-3) of 10 % ferric chloride were observed for any formation of precipitates and any color change. A bluish-black or brownish green precipitate indicated the presence of tannins.

Test for saponins



1 g of each powdered dried stain was separately boiled with 10ml of distilled water for 10minutes. The mixture was filtered while hot and allowed to cool. The following tests were then carried out. Demonstration of frothing: 2.5 ml of filtrate was diluted to 10ml with distilled water and shaken vigorously for 2minutes (frothing indicated the presence of saponins in the filtrate).

Test for alkaloids

1 g of powdered sample of each specimen was separately boiled with distilled water and 10 ml hydrochloric acid on a water bath and filtered. The pH of the filtrate was adjusted with ammonia to about 6-7. A very small quantity of the following reagents was added separately to about 0.5 ml of the filtrate in a different test tube and observed. Picric acid solution. 10% tannic solution. Mayer's reagent (Potassium mercuric iodide solution). The test tubes were observed for coloured precipitates or turbidity.

Test for amino acids

To 2ml of sample added 2ml of ninhydrin reagent and kept in water bath for 20 minutes. Appearance of purple color indicated the presence of amino acids the sample.

Analytical characterization of plant extracts

UV-vis- Spectrophotometer (UV-vis Spectra).

The quantitative determination of various analysis UV vis spectrophotometer is use .Is also used in analytical chemistry to find out transition metal ions, highly conjugated organic compounds and biological macromolecules. UV vis sepctrophotometry used for analysis the plant extracts and most preferred in pharmacopoeias [45].

Fourier Transform infrared Spectroscopy (FT-IR).

Fourier transform infrared spectroscopy used to measure infrared absorption and emission spectra to find out organic compounds found in the plant extract. To obtain infrared spectrum of absorption, emission, and photoconductivity of solid, liquid, and gas FTIR technique most suitable. For the detection of different function groups FTIR is preferred. [46].

Gas Chromatography (GC).

GC is the preliminary technique for the analysis, identifying, and quantifying the presence of constituents. It is use in investigations of several biochemical pathways in one analysis [47]

High-performance liquid Chromatography (HPLC).

HPLC can be used for detection of the amount of steroids in biological analysis. It requires the high sensitivity because of the low concentrations encountered and adequate sample clean up [4].

Biological Activities

Antimicrobial activity

For the detection of the antimicrobial activity of ethanolic extract the diffusion method is use .In analysis of Calendula tripterocarpa, Centarea sinaica, Centaurea pseudosinaica, Koelpinia linearis, Plectranthus arabicus, Plectranthus asirensis and Tripleurospermum auriculatum this method is prefer [10].

Anti-oxidant activity

In the analysis of the inflammation, autoimmune, cardiovascular, diabetes, neuro degenerative diseases, and even cancer the reactive oxygen and nitrogen species is related to many diseases. In several clinical studies the medicinal plants extracts play the important role in pathogenesis diseases as a antioxidant. The Malva species of plant shows the antioxidant effects. Moreover, distinct plant parts, including leaves, flower, petioles, stem, and seeds, have been investigated for antioxidant analysis [41].

Anti-bacterial activity

The screening the antibacterial activity of the dried extracts is carried out under the Gram-positive and Gram-negative bacteria. For the study of antibacterial analysis Salmonella typhi, Escherichia coli 12079, Escherichia coli 2799, Pseudomonas aeruginosa, Salmonella enteritidis, Aceto bacteria type of bacteria is used. [42].

Anti-fungal activity

The colocasia esculenta confirms the anti fungal activity and cystein protease inhibitor cystatin is isolated. The plant shows toxic effect on the mycelium growth of phytopathogenic fungi [43].

Anti-inflammatory

The anti inflammatory analysis of the C. spinosa leaf extract reduced edema on swiss albino mice. The C. Spinosa extract reduced the dermis thickness and immune cell infiltration in the inflammatory site. It also shows to exhibit anti inflammatory activity on human peripheral blood mononuclear cells [44].

Anti-cancer activity

The plant Malva species gives promising effect on chemo radiotherapy-induced mucositis. The olive polyphenols study finds in olive leaf are able to modulate and connect to pathway and to retard development and growth of cancer [41, 49].

Conclusions

The medicinal plant extracts is use in various cultures traditionally. The number of plant species having the disease curing capacity and shows the presence of phytochemical constituents. The researchers confirm the anti-bacterial, anti-inflammatory, anti-fungal, anti-microbial, anti-cancer and anti-oxidants activity in plant extracts. The plant extracts study gives zero side effects and low coast medicine to treatments on various diseases. Due to availability of plant in various regions in different climates conditions gives scope of analysis the phytochemical and biological activities of novel plants.



Acknowledgement

Authors are very much thankful to the HOD, Department of Chemistry, Dr.Mrs.Madhuri S.Patil, J.D.M.V.P. Samaj's, Shri. S. S. Patil Art's, Shri. Bhausaheb T. T. Salunkhe Commerce and Shri. G. R. Pandit Science College, Jalgaon for her continuous support, guidance and encouragement.

Conflicts of interest

The authors declare no conflict of interest.

References

- [1] Kalidindi, N., Thimmaiah, N. V., Jagadeesh, N. V., Nandee, R., Swetha, S., & Kalidindi, B.. Antifungal and antioxidant activities of organic and aqueous extracts of *Annona squamosa* Linn. leaves. *Journal of Food and Drug Analysis*, 2015;23(4), 795-802. doi:10.1016/j.jfda.
- [2] T.V Krishnapriya, A. Suganthi. Biochemical and phytochemical analysis of colocasia esculenta (L.) Schott tubers,2017; 2(3):21-25.
- [3] K. Sri Rama Murthy, N. Lakshmi and D. Raghu Ramulu et al. Biological activity and phytochemical screening of the oleoresin of *Shorea robusta* Gaertn. F. *Tropical and Subtropical Agroecosystems*, 14 2011: 787 - 791.
- [4] Abiodun Bukunmi Aborisade, Adewale Adetutu, Abiodun OlusojiOwoade et al. Phytochemical and Proximate Analysis of Some Medicinal Leaves, *Clinical Medicine Research*, 2017; 6(6): 209-214.
- [5] Sinan, K. I., Zengin, G., Zheleva-Dimitrova, D., Etienne, O. K., Fawzi Mahomoodally, M., Bouyahya, A., ... Orlando, G. (2020). Qualitative Phytochemical Fingerprint and Network Pharmacology Investigation of *Achyranthes aspera* Linn. Extracts. *Molecules*, 25(8), 1973. doi:10.3390/molecules25081973.
- [6] Sarikurkcu, C., Locatelli, M., Tartaglia, A., Ferrone, V., Juszczak, A. M., Ozer, M. S., ... Tomczyk, M. Enzyme and Biological Activities of the Water Extracts from the Plants *Aesculus hippocastanum*, *Olea europaea* and *Hypericum perforatum* That Are Used as Folk Remedies in Turkey. *Molecules*, 2020. 25(5), 1202. doi:10.3390/molecules25051202.
- [7] Senhaji, S., Lamchouri, F., & Toufik, H. (2020). Phytochemical Content, Antibacterial and Antioxidant Potential of Endemic Plant *Anabasis arctioides* Coss. & Moq. (Chenopodiaceae). *BioMed Research International*, 2020, 1-16. doi:10.1155/2020/6152932.
- [8] F. A. Alasmay, E. A. Assirey, R. M. El-Meligy et al., Analysis of *Alpina officinarum* Hance, chemically and biologically \rightarrow , *Saudi Pharmaceutical Journal*, <https://doi.org/10.1016/j.jsps.2019.09.007>.
- [9] Tabassum, S., Zia, M., Carcahe de Blanco, E.J. et al. Phytochemical, in-vitro biological and chemo-preventive profiling of *Arisaema jacquemontii* Blume tuber extracts. *BMC Complement Altern Med* 19, 256 ,2019. <https://doi.org/10.1186/s12906-019-2668-4>.
- [10] Al-Saleem, M.S., et al. Phytochemical standardization and biological activities of certain desert plants growing in Saudi Arabia. *Saudi Pharmaceutical Journal*,2017;<https://doi.org/10.1016/j.jsps.2017.12.011>.
- [11] Asaolu M.F.,Oyeyemi O.A.,Olanlokun J.O. Chemical Compositions, Phytochemical Constituents and in vitro Biological Activity of Various Extracts of *Cymbopogon citratus*. (2009) *Pakistan Journal of Nutrition* 8(12), 10, 516 DOI:10.3923/pjn.2009.1920.1922.
- [12] Jin, L., Schmied, M., Gaafary, M. E., Zhang, X., Syrovets, T., & Simmet, T. A comparative study on root and bark extracts of *Eleutherococcus senticosus* and their effects on human macrophages. *Phytomedicine*, 2020. 153181. doi:10.1016/j.phymed.2020.153181.
- [13] S. Susmitha, K.K. Vidyamol, P. Ranganayaki and R. Vijayaragavan. Phytochemical Extraction and Antimicrobial Properties of *Azadirachta indica* (Neem), *Global J. Pharmacol*, 2013; 7 (3): 316-320, 2013 DOI: 10.5829/idosi.gjp.2013.7.3.1107.
- [14] Ratha, M, Subha, K, Senthilkumar. G and Panneerselvam.A. Screening of phytochemical and antibacterial activity of *Hemidesmus indicus* (L.) and *Vetiveria zizanioides* (L.). *European Journal of Experimental Biology*,2012;2 (2):363-368.
- [15] Sulborska, A., Konarska, A., Matysik-Woźniak, A., Dmitruk, M., Weryszko-Chmielewska, E., Skalska-Kamińska, A., & Rejdak, R. Phenolic Constituents of *Lamium album* L. subsp. *album* Flowers: Anatomical, Histochemical, and Phytochemical Study. *Molecules*, 2020; 25(24), 6025. doi:10.3390/molecules25246025.
- [16] Abdelhafez OH, Othman EM, Fahim JR, et al. Metabolomics analysis and biological investigation of three Malvaceae plants. *Phytochemical Analysis*.2019;1-11. <https://doi.org/10.1002/pca.2883>.
- [17] Sinan, K. I., Chiavaroli, A., Orlando, G., Bene, K., Zengin, G., Cziáky, Z., Ferrante, C. Evaluation of Pharmacological and Phytochemical Profiles of *Piptadeniastrum africanum* (Hook.f.) Brenan Stem Bark Extracts. *Biomolecules*,2020;10(4),516. doi:10.3390/biom10040516
- [18] Masoko, P., & Masiphphethu, M. V. Phytochemical Investigation, Antioxidant and Antimycobacterial Activities of *Seckubria pinnata* (Lam) Thell Extracts Against *Mycobacterium smegmatis*. *Journal of Evidence-Based Integrative Medicine*, 2019; 24, 2515690X1986610. doi:10.1177/2515690X19866104
- [19] Shimon Ben-Shabat, Ludmila Yar Molinsky, Daniel Porat, Arik Dahan et al. Antiviral effect of phytochemicals from medicinal plants, Applications and drug delivery strategies, *Drug Delivery and Translational Research*,2019; <https://doi.org/10.1007/s13346-019-00691-6>.
- [20] Rajesh Kumar Meena, Rishikesh Meena, Dinesh Kumar Arya, Sapana Jadoun, Renu Hada, Roopa Kumari et al. Synthesis of Silver Nanoparticles by *Phyllanthus emblica* Plant Extract and their Antibacterial Activity, *Material Science Research India*,2020,17(2):136-145
- [21] Chandra Subhash, Saklani Sarla, Singh Jayardhan. Phytochemical screening of Garhwal Himalaya wild edible tuber *Colocasia esculenta*. *International research journal of pharmacy*. 2012; 3 (3):181-186.
- [22] Ting IP. Plant physiology. Addition wesely services in life science to allelopathic activity. *J. Environ. Qual.* 1982; 30:1631-1635.
- [23] Shi J, Arunachalam K, Yeung D, Kakuda Y, Mittal G, Jiang Y. Saponins from edible legumes chemistry, processing and health benefit. *J Med Food*. 2004; 7:67- 78.
- [24] Barre JT, Bowden FB, Coll JC, Jesus J, Fuente VE, Janairo GC. A bioactive triterpene from *Lantana camara*. *Phytochemistry*. 1997; 45:321-324.
- [25] Habtemariam S, Gray AI, Waterman PG. A new antibacterial sesquiterpene from *Lantana camara*. *Phytochemistry*. 1997; 56:140-143.
- [26] Scortichini M, Pia RM. Preliminary in vitro evaluation of the antimicrobial activity of terpenes and terpenoids towards *Erwinia amylovora* (Burkill) Winslow. *Journal of applied bacteriology*. 1991; 71:109-112.
- [27] Brain FH, Thomas-Bigger J, Goodman G. The pharmacological basis of therapeutics (Macmillan, New York, USA). 1985, 7.
- [28] Sule WF, Okono IO, Joseph TA, Ojezele MO, Nwanze JC. In vitro antifungal activity of *Sennaalata* Linn. Crude leaf extracts. *Adv*



- App Sci Res. 2010; 1:14-26.
- [29] Frankel E. Nutritional benefits of flavonoids, International conference on food factors: chemistry and cancer prevention, Hamamastu, Japan, Abstracts, C-2, 1995.
- [30] Barakat MZ, Shahab SK, Darwin N, Zahemy EI. Determination of ascorbic acid from plants. *Annals of Biochemistry*. 1993; 53:225-245.
- [31] Edward P.C, Varrrd E.T, and Lynn RB. 1970. A Textbook of Pharmacognosy, Henry Kinston, London.
- [32] Trease, G.E and Evans W.C. 1989. Pharmacognosy, Balleire Tindal, London.
- [33] Ram M.S, Ilavazhagan G, Sharma S.K, Dhanraj S.A, Suresh B, Parida M.M, Jana A.M, Kumar Devendra and Selvamurthy W. 71: 377-382.
- [34] Nagalakshmi M.A.H, Thangaduri, D, Muralidharrao, D and Pullaiah T. Photochemical and antimicrobial study of Chukrasiatabularis leaves. *Fitoterapia*. 2001; 72: 62-64.
- [35] Chowdhury R, Choudhury M and Mohammad H, Rashid A. Antimicrobial activity of *Toona ciliata* and *Amoorarahituka* *Fitoterapia*. 2003; 74: 155-158.
- [36] Lavanya T.M, Murthy K.S.R, Reddy N.S. and Rao K.R.S.S. Phytochemical and antimicrobial study of *Aglaia spectabilis* leaf extracts. *Journal of Tropical Medicinal Plants*. 2006;7:163-168.
- [37] Murthy K.S.R and Kandimalla, N. Antimicrobial spectrum and Phytochemical study of *Walsura trifoliata* (A.Juss.) Harms. (Meliaceae) bark extracts *Journal of Pharmacology and Toxicology*. 2008; 3: 267- 71.
- [38] Bai D. Traditional Chinese materia; a respect and prospect. *Plant Medica*. 1990; 56:5002.
- [39] Tabassum S, Ahmed M, Mirza B, Naeem M, Zia M, Shanwari ZK, Khan GM. Appraisal of phytochemical and in vitro biological attributes of an unexplored folklore: *Rhus Punjabensis* Stewart. *BMC Complement Altern Med*. 2017 Dec; 17(1):146.
- [40] Dou, Q. P. Tea in Health and Disease. *Nutrients*, 2019; 11(4), 929. Doi: 10.3390/nu11040929.
- [41] Sharifi Rad J, Melgar Lalanne G, Hernández Álvarez AJ, et al. Malva species: Insights on its chemical composition towards pharmacological applications. *Phytotherapy Research*. 2019;1-22. [https://doi.org/10.1002/ ptr.6550](https://doi.org/10.1002/ptr.6550).
- [42] Saleh-e-In et al. Pharmacological effects of the phytochemicals of *Anethum sowa* L. root extracts *BMC Complementary and Alternative Medicine* (2016) 16:464 DOI 10.1186/s12906-016-1438-9.
- [43] Pawar HA, Choudhary PD, Kamat SR. An Overview of Traditionally Used Herb, *Colocasia esculenta*, as a Phytomedicine. *Med Aromat Plants (Los Angeles)*. 2018; 7: 317. doi:10.4172/2167-0412.1000317.
- [44] Zhang, H., & Ma, Z. Phytochemical and Pharmacological Properties of *Capparis spinosa* as a Medicinal Plant. *Nutrients*. 2018;10(2), 116. doi:10.3390/nu10020116
- [45] A.R. Bilia, in *Encyclopedia of Analytical Science* (Second Edition), 2005.
- [46] Raveendran Sindhu, Ashok Pandey, in *Industrial Biorefineries & White Biotechnology*, 2015.
- [47] R.A. Shellie, in *Encyclopedia of Forensic Sciences* (Second Edition), 2013.
- [48] R. Lafont H. Rees, in *Comprehensive Molecular Insect Science*, 2005.
- [49] Boss, A., Bishop, K., Marlow, G., Barnett, M., & Ferguson, L. (2016). Evidence to Support the Anti-Cancer Effect of Olive Leaf Extract and Future Directions. *Nutrients*, 8(8), 513. doi:10.3390/nu8080513.