A REVIEW ON IMMUNOMODULATORY ACTIVITY OF HERBAL DRUGS IN INDIAN TRADITIONAL SYSTEMS OF MEDICINE

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ABSTRACT

Immunomodulators play a key role in immunity of each animal in this world. Almost all animals have their own system to produce different immunomodulators at different time. Herbal medicines constitute a major component in all traditional and alternative systems of medicines like siddha, ayurveda, homeopathy, naturopathy, yogic science and native american medicines. This review emphasizes on twenty-five herbal drugs including *Withania somnifera, Morus Alba Linn, Acacia catechu, Achillea wilhelmsii, L. Panax ginseng, Garlic (Allium Sativum), Terminalia Arjuna, Rhus toxicodendron* and many more for their Immunomodulatory potential. In addition, many of the immune-boosting and health promoting drugs are available in the market in various dosage forms like in the form of tablets, capsules, candies, juices, kadha, tea, chyawanprash, are also mentioned. Increase in the levels of total leucocytes count (TLC), Differential leucocytes count (DLC), foot paw volume, phagocytic index was observed in delayed type hypersensitivity (DTH) response, Neutrophil adhesion test, Acute paw anaphylaxis, phagocytosis, etc, are *in vivo* and *in vitro* biological screening methods used for the immunomodulatory activity. [2] Accordingly, this review provides numerous evidences which indicates that these medicinal drugs can be used for treating and boosting immune system and related complications.

Keywords: Immune framework, Immune rule, Plant drugs, immunity boosters, marketed preparations.

INTRODUCTION

Different combinations with immunomodulatory potential have been confined from lower organism. Drugs are used for modification of single pathways or targets that are of limited worth in safe related medicines as invulnerability is exchange between various organs, cells and signalling particles. Since botanicals are artificially confounding and different, could hence give reasonable mixes of synergistic moieties to treat immune dysfunctions. According to WHO, about three-quarters of complete people relies on standard fixes (basically flavours) for fundamental clinical benefits. Surely, flavours and moreover plants are oldest friends of mankind. [3] They give food & shelter just as serve to fix different ailments. Herbal medicines, every so often called standard or ordinary prescription, has reliably existed by one way in different social orders & improvements, Ayurveda, the Indian standard plan of prescription, lays complement on progression of prosperity thought of protection against different diseases. A couple of plants from these compositions have been perused for their immunomodulatory properties & found to have ability of giving new stages to safer, synergistic, blended beverage immune-drugs. 34 plants have been perceived as Rasayanas in the Ayurvedic course of action of medicine. Other than these, couple of other therapeutic plants Which are prohibited as Rasayana in Ayurveda has moreover found to have immunomodulatory properties.[4]

History of Immunology

Immunology may be a science that ganders at development & limit of immunized structure. It starts from medication & early assessments on explanations behind protection from illness. Most rapid well-known notification of immunity was throughout plague of Athens in 430 before Christ. Historiographer seen individuals WHO have recovered from a past scene of infection may sustain weakened while not obtaining trouble in ensuing time. In eighteenth century, Pierre-Louis Moreau Diamond State Maupertuis created investigations with scorpion poison & saw that individual canines & mice were run-resistant to the current poison This & varied study of no heritable safety were on these lines mishandled by biologist in his improvement of vaccination & his planned germ speculation of contamination. Pasteur's theory count as a modern theory of contamination, just like the miasma theory. [5]

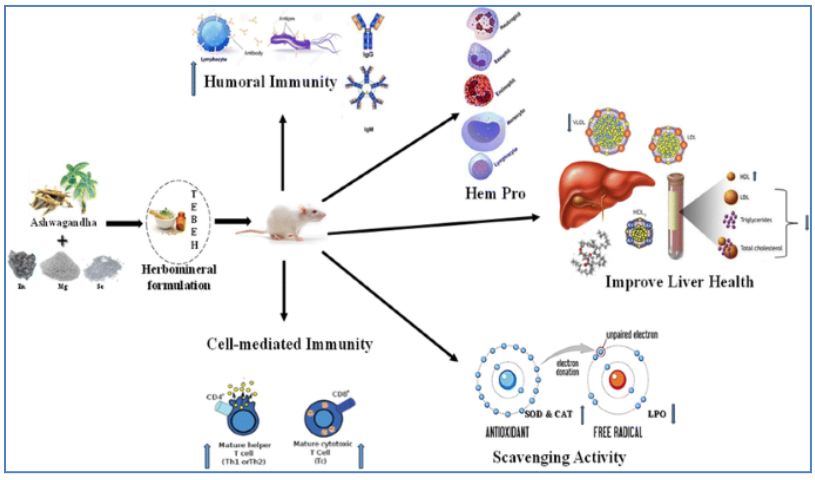

Fig. 1: Immunomodulatory Properties & biomarkers Characterization

Methods for Testing Immunological Factors

Typical cycle to screening is to crash single fixing or single refined half from within reach cures, decide its bioactivity by admirable medical specialty means that. Whole animal model is top medical specialty screening model that is essential at part of drug assessment since it will clearly answer ampleness, lucky impact & hazard of plans out & out. a handful in vitro, in vivo systems for medical specialty screening of study plants having immunomodulatory improvement are recorded. [6]

In Vitro Approaches

- Inhibit histamine level that is obtained from past cell.
- Mitogen started lymphocyte duplication
- T cell duplication Inhibit
- PFC test *in vitro.*

In Vivo Approaches

- Spontaneous safe framework afflictions in animals
- Acute systemic anaphylaxis in rodents
- Anti-anaphylactic activity
- Passive cutaneous anaphylaxis
- Arthurs type immediate hypersensitivity
- Delayed type hypersensitivity
- Reversed passive Arthurs reaction
- Adjuvant arthritis in rodents

It's undeniably a reality that standard headways of fixes constantly expected massive part in party as a rule clinical estimated essential. Methodology of game-plans which are seen as Indian in start or structures of arrangement, that is came in India from outside & which got profession of Indian medicine. India has mysterious furthest reaches of having such six seen upgrades obviously of activity in a particular requesting, like Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homeopathy. [7] Ayurveda, being the science of life, propagates the gifts of nature in maintaining healthy and happy living. Ayurveda's extensive knowledge base on preventive care, derives from the concepts of "Dinacharya" - daily regimes and "Ritucharya" - seasonal regimes to maintain healthy life. It is a plant-based science. The simplicity of awareness about oneself and the harmony each individual can achieve by uplifting and maintaining his or her immunity is emphasized across Ayurveda's classical scriptures. [8]

The Siddha system of Medicine is one of the traditional medical systems, providing preventive, promotive, curative, rejuvenative and rehabilitative health care by adopting scientific and holistic approach. Siddhars have recommended certain basic lifestyle guidelines -- preventive measures (Viti) that help to prevent diseases.

Rejuvenating procedures (K¡yaka¼pam) increase our immunity. Siddha intervention activates physiological processes that influence metabolic and immunological status and offers cost effective palliative care for the elderly patients. [9] As per Unani classical wisdom, improving immunity with immune boosters is one of the key approaches for prevention of disease and maintenance of health. Therefore, a strategy to enhance immunity and provide symptomatic relief in upper respiratory tract infection is advocated in these guidelines for qualified Unani Medicine practitioners. [10]

Immunomodulation by Allopathic Drugs

Immunosuppressant accumulates basically reducing in barrier against defilements; stress may ensure balancing standard or chemotherapeutic parts. Clinical places of immunosuppressant are according to going with.

- To cover excusal of moved organs & tissues
- To cover join versus-have torture (for instance response of lymphocytes in the join to have antigens) in bone marrow moves.

Immunostimulant

Immunostimulant join a prophylactic thought that spins around initiation of our cloudy safe system. This deduces essentially non-antigen subordinate actuating of limit & comfort of granulocytes, macrophages, supplement & customary killer (NK) cells. [11]

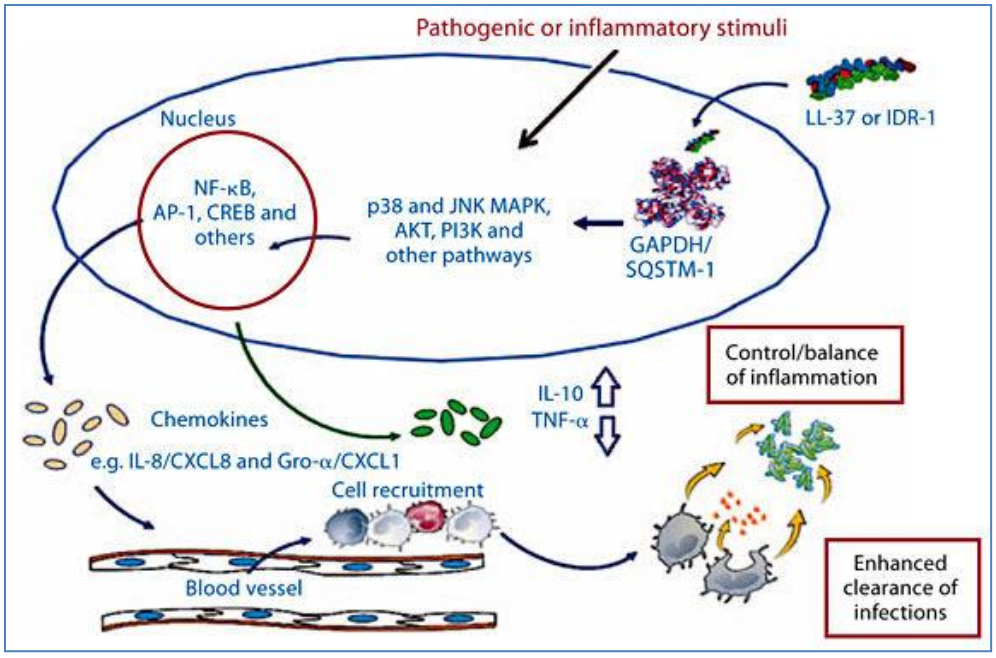

Fig. 2: Mechanism of immunomodulatory activity of LL-37 and IDR-1

MEDICINAL PLANTS INVESTIGATED FOR IMMUNOMODULATORY POTENTIAL

Plants are considered as fundamental chronicles of ordinary segments having massive supportive worth. It is assessed that around 2, 50,000 growing plant species are found on earth, of which around 1, 25,000 happen in tropical woodlands & around 2000 sorts of higher plants are utilized for therapeutic purposes all through world. India harbours in excess of 45,000 plant source, these thousands have kept up with having supportive properties. Enormous approaches of tropical plant have not yet been manhandled carefully for their pharmacological properties or substance constituents. Mixes disconnected from supportive plants will fill in as lead particles for advancement of definite & better prescriptions against different illnesses & in the long run accessible planned drugs when utilized in combination. One of the immediate developing areas of medication development involves the search for novel immunomodulatory specialists having either immune-stimulatory or immunosuppressant improvement that could be utilized for therapy of different safe dysfunctions or in event of extra cancer. Number of plants utilized in Indian traditional system of medicines has been displayed to engage safe immune responses. several unique substances have also been isolated. From these plants, an outline of plants sourced from our traditional medicinal plants investigated for immunomodulatory action. [12]

HERBAL PLANTS AS IMMUNOMODULATOR

- ***Withania somnifera :*** Leemol Davis.*et.al.,* (2000) studied the Immunomodulatory activity of *Withania somnifera.* It was concluded that administration of an extract from the powdered root of the plant *Withania somnifera* was found to stimulate immunological activity in Babl/c mice.
- ***Morus Alba Linn:*** Shendige Eswara Rao Bharani. *et.al,* (2010) evaluated the Immunomodulatory activity of methanolic extract of Morus alba Linn. (mulberry) leaves. It was concluded that Morus alba increases both humoral immunity and cell mediated immunity.
- ***Acacia catechu:*** M.A.Sunil.*et.al*. (2019) evaluated the Immunomodulatory activities of *Acacia catechu*, a traditional thirst quencher of South India. The result was concluded that the immunomodulatory effects of *A. catechu* extracts on humoral, cell mediated and non-specific immune functions.
- ***Achillea wilhelmsii:*** Fariba Sharififar.*et.al* (2009) studied the Immunomodulatory activity of aqueous extract of Achillea wilhelmsii C. Koch in mice. It was concluded that *A. wilhelmsii* showed a stimulatory effect on both humoral and cellular immune functions in mice. [21].
- ***Panax ginseng:*** Zubair Ahmed Ratan.*et.al*. (2021) evaluated the adaptogenic effects of *Panax ginseng* on modulation of immune functions. It was reported that ginseng as an immune-modulating agent in attempt to provide a valuable starting point for future studies on the herb and the human immune system.
- ***Garlic (Allium Sativum):*** Mouna Moutia. *et.al*. (2018) evaluated the *In Vitro* and *In Vivo* Immunomodulator Activities of *Allium sativum* L. the result was found that garlic was found to be able to maintain the immune system homeostasis and to exhibit beneficial effects on immune cells especially through regulation of proliferation and cytokine gene expression.

- ***Terminalia Arjuna:*** Kamal Singh Rathore (2018) examine the Study of Immunomodulatory activity of *Terminalia arjuna* (roxb) bark on in-vitro neutrophils. The result was concluded that in-vitro immunomodulatory activity led to the conclusion that the chloroform extract and isolated compound of Terminalia arjuna bark showed predominantly significant activity on in-vitro human neutrophils in all parameters as compared to other extracts.
- ***Rhus toxicodendron:*** C R Patil.*et.al* (2009) studied the Immunomodulatory activity of Toxicodendron pubescens in experimental models. The result was concluded that *Rhus tox* possesses immunostimulatory activity in its crude form as well as in homeopathically diluted forms. These effects appeared to be concentration dependent as higher dilutions had less potent effects.

Sr. No.	Plant Image	Botanical Name (Family)	Common Name	Part used	Method	Result	References
1.		*Adhatoda vasica Linn.* (Acanthaceae)	Malabar nut, adusa	Leaves	DTH, Neutrophil adhesion test	A.vasica linn positively modulates the immunity of the host.	[13]
2		*Abutilon indicum* (Malvaceae)	Kanghai, Indian mallow	Leaves	HA titre, DTH, Neutrophil adhesion & Carbon clearance test	Aqueous & ethanolic extracts of A.indicum leaves may be beneficial in the treatment of impaired immunity.	[14]
3		*Aegle marmelos* (Rutaceae)	Bael, Golden apple	Fruit	Neutrophil adhesiontest, Carbon clearance test, Mice lethality test, indirect HA test	FEAM possesses potential for augmenting immune activity by cellular and humoral mediated mechanisms more at low dose (100 mg/kg) than high dose (500 mg/kg).	[15]
4		*Alstonia scholaris* (Apocynaceae)	Devil's tree, chitvan	Stem bark	DTH response by SRBC, phagocytic index and cyclophosphamid- induced myelosupression model	Stimulate the humoral immune response and cell-mediated immune response	[16]
5		*Tinospora cordifolia* (Menispermaceae)	Guduchi, giloy	Stems	HA titre, cyclophosphamide	Promising immunomodulatory agent	[17]
6		*Baliospermum montanum* (Euphorbiaceae)	Wild castor, danti	Roots	Phagocytosis such as neutrophil locomotion, chemotaxis, immunostimulant activity of phagocytosis of killed *Candida albicans* and qualitative nitroblue tetrazolium test by using human neutrophils.	aqueous extract of *Baliospermum montanum* stimulate cell-mediated immune system by increasing neutrophil function.	[18]

7		*Bauhinia variegate* (Caesalpiniaceae)	Kachnar, orchid tree	Stem bark	nitroblue tetrazolium test, phagocytosis of killed Candida albicans, candidacidal assay, neutrophil locomotion and chemotaxis.	acetone: water and isolated compound of Bauhinia variegata Linn stem bark showed predominantly significant activity on *in vitro* human neutrophils in all parameters, standard and control at different concentration indicating the possible immunostimulating effect.	[19]
8		*Bacopa monnieri* (Plantaginaceae)	Brahmi	Whole plant	HA titre, cyclophosphamide	Promising immunomodulatory agent	[20]
9		*Carica papaya* (Caricaceae)	Papaya, papita	Pulp & seeds	STZ-induced diabetic rats.	hypoglycemic effect on diabetic ratsusing chloroform, *n*-hexane or ethanol	[21]
10		*Cinnamomum tamala* (Lauraceae)	Bay leaf, tejpat	Leaves	transit intestinal method	Bay leaves extract in 30% have best antidiarrhea activity	[22]
11		*Citrus aurantifolia* (Rutaceae)	Lime, kaghzi-nimbu	Conc. lime juice	mitogen activated culture mononuclear cells.	juice could significantly inhibit the proliferation of phytohaemaglutinin activated mononuclear cells at 250 and 500 microgram per litre of the juice extract	[23]
12		Piper longum (Piperaceae)	pippali	Fruits	hemagglutination titer, macrophage migration index, and phagocytic index	found to activate macrophages, as shown by an increased macrophage migration index and phagocytic index, indicating immune-stimulatory activity	[24]
13		*Nelumbo nucifera* (Nelumbonaceae)	Indian lotus, kamal	Seeds	Neutrophil adhesion test, NBT reduction, Phagocytic response using ‘carbon clearance’ method	LSPS can be used as an antitumor and immunomodulatory agent.	[25]

14		*Ocimum sanctum* *(Lamilaceae)*	Holy basil, tulsi	Leaves	Acute oral toxicity test was performed as per OECD -23 guidelines & DTH response in mice	Increase in DTH reaction in mice in response in T cell dependent antigen revealed the stimulatory effect of *Ocimum sanctum* on T cells.	[26]
15		*Solanum torvum* (Solanaceae)	Turkey berry, bhura	Leaves	Assays were done using ready to use Randox kits and photomicrographs of various tissues were prepared after histological staining.	potent modulatory abilities that could influence increases in lymphocytes, WBC and granulocytes & also possesses hepato-protective properties.	[27]
16		*Terminalia arjuna* *(Combretaceae)*	Arjuna	Bark	*in-vitro* human neutrophils	chloroform extract and isolated compound of Terminalia arjuna bark showed predominantly significant activity on in-vitro human neutrophils in all parameters as compared to other extracts	[28]

Commercially available immune-boosting Formulation

Various immune-boosting and health promoting herbal drugs are available in the form of powders, tablets, capsules, juices, syrups, extract, chyawanprash, drops, tea & more in the market by different manufacturers that are meant for adults, kids & both with so many benefits such as enhancing strength & stamina, cold & cough, blood purifier, and many more. [29] Some of them are given in Table:

Table 2: Commercially available immune-boosting Formulation

Sr. No.	Dosage Foams	Active ingredients	Brand Name
1.	**Tablets**	Ashwagandha Giloy Haldi Amla	Dabur Ltd.
2.	**Capsules**	Shatavari Punarnava	Himalaya global holding Ltd.
3.	**Powders**	Ginger Guggul	Dabur Ltd.
4.	**Juices**	Amla Wheat grass Neem Karela	Zandu reality Ltd.
5.	**Syrups**	Ashoka Amaki Tulsi	Patanjali Ayurveda Ltd.
6.	**Pastes**	Chawanprash Avleha	Zandu reality Ltd.

CONCLUSION

Traditionally, herbal medicines have been utilized from decades as a remedy for a number of diseases. In this review, twenty-five herbal drugs are mentioned that processing immunomodulatory activity. The immunomodulatory activity of herbal drugs plays a vital role for an individual's body system; where this is the term which is related to every disease that causes mortality everywhere throughout the world. Thus, we need to focus on the immunomodulatory activity of herbs and should adopt a new approach to the protective role of these medicinal plants, so that we can come out with more concrete solution for phytomedicine research and medication improvement for such a disease. This review is an overview of the different herbal drugs and various immunity boosters available in different dosage forms as a potential used in the protection of an individual's health and immune system. However, we can safely state that herbal medicines have enormous potential to provide some remarkable drugs.

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REFERENCES

1. Ziauddin M, Phansalkar N, Patki P, Diwanay S, Patwardhan B. Studies on the immunomodulatory effects of Ashwagandha. Journal of ethnopharmacology. 1996 Feb 1;50(2):69-76.
2. Tiwari R, Latheef SK, Ahmed I, Iqbal H, Bule MH, Dhama K, Samad HA, Karthik K, Alagawany M, El-Hack ME, Yatoo MI. Herbal immunomodulators-a remedial panacea for designing and developing effective drugs and medicines: current scenario and future prospects. Current drug metabolism. 2018 Mar 1;19(3):264-301.
3. Belapurkar P, Goyal P, Tiwari-Barua P. Immunomodulatory effects of triphala and its individual constituents: a review. Indian Journal of Pharmaceutical Sciences. 2014 Nov;76(6):467.
4. Tripathi JS, Singh RH. The concept and practice of immunomodulation in ayurveda and the role of rasayanas as immunomodulators. Ancient science of life. 1999 Jul;19(1-2):59.
5. Borse S, Joshi M, Saggam A, Bhat V, Walia S, Marathe A, Sagar S, Chavan-Gautam P, Girme A, Hingorani L, Tillu G. Ayurveda botanicals in COVID-19 management: An in silico multi-target approach. Plos one. 2021 Jun 11;16(6):e0248479.

6. Aphale S, Shinde K, Pandita S, Mahajan M, Raina P, Mishra JN, Kaul-Ghanekar R. Panchvalkala, a traditional Ayurvedic formulation, exhibits antineoplastic and immunomodulatory activity in cervical cancer cells and C57BL/6 mouse papilloma model. Journal of Ethnopharmacology. 2021 Nov 15;280:114405.
7. Agarwal R, Diwanay S, Patki P, Patwardhan B. Studies on immunomodulatory activity of Withania somnifera (Ashwagandha) extracts in experimental immune inflammation. Journal of Ethnopharmacology. 1999 Oct 1;67(1):27-35.
8. Mungantiwar AA, Nair AM, Shinde UA, Dikshit VJ, Saraf MN, Thakur VS, Sainis KB. Studies on the immunomodulatory effects of Boerhaavia diffusa alkaloidal fraction. Journal of Ethnopharmacology. 1999 May 1;65(2):125-31.
9. Suresh Gupta M, Shivaprasad HN, Kharya MD, Rana AC. Immunomodulatory activity of the ayurvedic formulation "Ashwagandha Churna". Pharmaceutical biology. 2006 Jan 1;44(4):263-5.
10. Chahar MK, Kumar DS, Lokesh T, Manohara KP. In-vivo antioxidant and immunomodulatory activity of mesuol isolated from Mesua ferrea L. seed oil. International immunopharmacology. 2012 Aug 1;13(4):386-91.
11. Shivaprasad HN, Kharya MD, Rana AC, Mohan S. Preliminary Immunomodulatory Activities of the Aqueous Extract of Terminalia chebula. Pharmaceutical Biology. 2006 Jan 1;44(1):32-4.
12. Singla LD, Pangasa A, Juyal PD. Caecal coccidiosis: efficacy of ayurvedic and allopathic coccidiostats in immunomodulated broiler chicks. InProceedings of the 12th International Conference of the Association of Institutions of Tropical Veterinary Medicine held from August 2007 Aug 19 (pp. 19-22).
13. Vinothapooshan G, Sundar K. Immunomodulatory activity of various extracts of Adhatoda vasica Linn. in experimental rats. Afr J Pharm Pharmacol. 2011 Mar 1;5(3):306-10.
14. Dashputre NL, Naikwade NS. Immunomodulatory activity of Abutilon indicum linn on albino mice. Int J Pharm Sci Res. 2010;1(3):178-84.
15. Lambole VB, Murti K, Kumar U, Bhatt SP, Gajera V. Phytopharmacological properties of Aegle marmelos as a potential medicinal tree: an overview. Int J Pharm Sci Rev Res. 2010 Nov;5(2):67-72.
16. Hussain MM, Mandal J, Bhattacharya K. Aerobiological, clinical, and immunobiochemical studies on Alstonia scholaris pollen from eastern India. Environmental monitoring and assessment. 2014 Jan;186(1):457-67.
17. Choudhary N, Siddiqui MB, Azmat S, Khatoon S. Tinospora cordifolia: ethnobotany, phytopharmacology and phytochemistry aspects. International Journal of Pharmaceutical Sciences and Research. 2013 Mar 1;4(3):891.
18. Patil KS, Jalalpure SS, Wadekar RR. Effect of Baliospermum montanum root extract on phagocytosis by human neutrophils. Indian journal of pharmaceutical sciences. 2009 Jan;71(1):68.
19. Patil JK, Jalalpure SS, Hamid S, Ahirrao RA. In-vitro Immunomodulatory Activity of extracts of Bauhinia vareigata Linn bark on Human Neutrophils.
20. Chaudhari KS, Tiwari NR, Tiwari RR, Sharma RS. Neurocognitive effect of nootropic drug Brahmi (Bacopa monnieri) in Alzheimer's disease. Annals of neurosciences. 2017;24(2):111-22.

21. Juárez-Rojop IE, Díaz-Zagoya JC, Ble-Castillo JL, Miranda-Osorio PH, Castell-Rodríguez AE, Tovilla-Zárate CA, Rodríguez-Hernández A, Aguilar-Mariscal H, Ramón-Frías T, Bermúdez-Ocaña DY. Hypoglycemic effect of Carica papaya leaves in streptozotocin-induced diabetic rats. BMC complementary and alternative medicine. 2012 Dec;12(1):1-1.

22. Rao CV, Vijayakumar M, Sairam K, Kumar V. Antidiarrhoeal activity of the standardised extract of Cinnamomum tamala in experimental rats. Journal of natural medicines. 2008 Oct;62(4):396-402.

23. Gharagozloo M, Ghaderi A. Immunomodulatory effect of concentrated lime juice extract on activated human mononuclear cells. Journal of ethnopharmacology. 2001 Sep 1;77(1):85-90.

24. Gani HM, Hoq MO, Tamanna T. Ethnomedicinal, phytochemical and pharmacological properties of Piper longum (Linn). Asian Journal of Medical and Biological Research. 2019 Apr 22;5(1):1-7.

25. Baregama C, Goyal A. Udaipur, Rajasthan, India. 2Professor & HOD, Bhupal Nobles' Institute of Pharmaceutical Sciences, BN University, Udaipur, Rajasthan, India. Correspondence address: Chetna Baregama, Assistant Professor, BR Nahata College of Pharmacy, Mandsaur University, Mandsaur, MP, India. European Journal of Molecular & Clinical Medicine (EJMCM).;7(10):2020.

26. Magesh V, Lee JC, Ahn KS, Lee HJ, Lee HJ, Lee EO, Shim BS, Jung HJ, Kim JS, Kim DK, Choi SH. Ocimum sanctum induces apoptosis in A549 lung cancer cells and suppresses the in vivo growth of Lewis lung carcinoma cells. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2009 Oct;23(10):1385-91.

27. Christi IV, Uma PT, Nagarajaperumal G, Mohan S. Phytochemicals detection, antioxidant and antimicrobial activity study on berries of Solanum torvum. Asian Journal Pharmaceutical and Clinical Research. 2018;11(11):418-23.

28. Jalalpure SS, Parameshawara C, Patil JK, Singh V. Effect of Terminalia arjuna (Roxb) bark extracts on human neutrophils. INDIAN DRUGS-BOMBAY-. 2006;43(8):619.

29. Sabina EP, Rasool MK, Mathew L. In vivo and in vitro immunomodulatory effects of Indian ayurvedic herbal formulation triphala on experimental induced inflammation. Pharmacologyonline. 2009; 2:840-9.