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Herbal Plants Used for Immunomodulatory Action: A Review

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ABSTRACT

The immune system is one of our most complex biological system in the body. Immunization may be active or passive. The active immunization involves stimulation with an antigen to develop immunological defences against a future exposure and Passive immunization involves administration of preformed antibodies to an individual who is already exposed to be exposed to an antigen. The use of a variety of agents to enhance immunological and nonspecific host defences and thus to modify the favorably is an exciting development in immunopharmacology that is such agents may act by increase the humoral antibody responses, enhancing the phagocytic activity of macrophages or modifying the cell-mediated immune response. Immunomodulatory agents originate from both plant and animal which increases the immune responsiveness of the body against pathogens by activating the non specific immune system. The immune system dysfunction is responsible for various diseases like allergy, asthma, arthritis, cancer and other infectious diseases. So modulation of immune responses to much required to controlling the various infectious diseases. The texts of traditional Indian medicine literature consist of a number of plants reputed to promote physical and mental health, improve defence mechanisms of the body and enhance longevity, lesser number of side effects against synthetic immunomodulatory agent.

KEY WORDS: Immunomodulatory agents, Immunological diseases, Immunostimulants, Immunosuppressant.

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1. IMMUNIZATION:

The immune system is one of our most complex biological systems in the body. The basic role of the immune system is to distinguish self from non-self¹.

Immunization may be active or passive. Active immunization involves stimulation with an antigen to develop immunologic defenses against a future exposure. Passive immunization involves administration of preformed antibodies to an individual who is already exposed or is about to be exposed to an antigen².

2. IMMUNOMODULATION THERAPY:

The development of agents that modulate the immune responses rather than suppress it has become an important area of pharmacology. The rationale underlying this approach is that such drug may increase the immune responsiveness of patients who have either selective or generalized immunodeficiency. The major potential uses are in immunodeficiency disorder, chronic infectious disease, and cancer. The AIDS epidemic has greatly increased interest in developing more effective immunomodulating drugs³.

3. IMMUNOSTIMULANT AND IMMUNOMODULATORS:

The use of a variety of agents to enhance immunological and non specific host defences and thus to modify the defences favorably is an exciting development in immunopharmacology. Such agents may act by:-Increase the humoral antibody responses. Enhancing the phagocytic activity of macrophages, or modifying the cell-mediated immune responses⁴.

Drugs like Amantadine and tilorane stimulate the humoral immune system. These are the drug which inhibit cellular/humoral or both immune response and have their major use in organ transplantation and autoimmune disease⁵.

4. IMMUNOMODULATORY HERBS:

Several Herbs have potent immunomodulatory action example (*Punica grantum, Baccopa monerae*) etc. They are mention in table no.1

Table 1: List of Plant Having Immunomodulatory Activity:⁶⁻⁷¹

S.N.	Plant Name	Part used	Extract	Model used
1.	<i>Hibiscusrosa sinensis</i>	Flowers	Hydro-alcoholic extract	Carbon clearance method, Cellular mediated immunity, Immunostimulatory
2.	<i>Cleome gynandra</i>	Aerial parts	Ethanollic extract	Carbon clearance method, Cellular mediated immunity, Immunostimulatory
3.	<i>Trikatu mega</i>	Aerial parts	Pe.Ether,Benzene , Choloroform	Carbon clearance assay, delayed hypersensitivity test
4.	<i>TriAmrit(Terminalia,Allium,Tinospora)</i>	Aerial parts	Pe.Ether,Benzene , Choloroform,	Carbon clearance assay, delayed hypersensitivity test
5.	<i>Nyctanthes arbortristis</i>	Leaf	Ethanollic extract	Humoral immunity, delayed-type hypersensitivity.
6.	<i>Cissampelos pareira</i>	Roots	Alkaloidal fraction	Humoral antibody titre
7.	<i>Bauhinia Vareigata</i>	Stem bark,	Acetone: water (70:30),	Human Neutrophils
8.	<i>Human Neutrophils</i>	Leaf	Methanollic	cellular immunity, humoral immunity
9.	<i>Tinospora cordifolia</i>	Stems	Ethanollic extract	DTH, Bone marrow cellularity and α -Esterase cells, Zinc sulphate turbidity test.
10.	<i>Balanite roxburghi,</i>	Leaf	Ethanollic extract	Carbon clearance test, serum immunoglobulin
11.	<i>Ficus carica</i>	Leaf	Ethanollic extract	Cellular immune response, Humoral antibody response

12.	<i>Capparis zeylanica</i>	Leaf	Alcoholic extract	Phagocytosis; Delayed hypersensitivity;
13.	<i>Trapa bispinosa</i>	Fruits	Aqueous extract	Neutrophils, Haemagglutination titre.
14.	<i>Aloe vera</i>	Leaves	Saline extract	Haematological, Serological studies.
15.	<i>Heracleum persicum</i>	Fruits	Aqueous Extract	Haemagglutination titre, Delayed, type hypersensitivity
16.	<i>Maltese plants</i>	Aerial parts	Petroleum ether, chloroform, ethanol, 50% aqueous ethanol and distilled water	lymphocyte activation, cell proliferation, cytotoxicity.
17.	<i>Picrorhiza scrophulariiflora</i>	Whole plant	Aqueous extract	Haemagglutination titre, Delayed type hypersensitivity
18.	<i>Tinospora cordifolia</i>	Stem	Alcoholic extract	Immunostimulant, macrophase chemotaxis
19.	<i>Ocimum sanctum</i>	Whole plant	Aqueous extract	Enhance the production of RBC, WBC and haemoglobin.
20.	<i>Bauhinia variegata</i>	Stem bark	Ethanollic extract	Neutrophil adhesion , Phagocytic activity
21.	<i>Chlorophytum borivilianum</i>	Roots	Ethanollic extract	In Vivo Phagocytosis Using Carbon Clearance Method
22.	<i>Morus alba linn.</i>	Leaf	Methanolic extract	Humoral immunity, serum immunoglobulin.
23.	<i>Aesculus indica</i>	Leaf	Petroleum ether	Neutrophil index, Neutrophil Adhesion
24.	<i>Ficus benghalensis</i>	Roots	methanolic extract	Hypersensitivity and hemagglutination reactions
25.	<i>Citrus</i>	Fruits	Concentrated	Cell proliferation assay, Immunoblotting

	<i>aurantifolia</i>		juice	
26.	<i>Cissampelos pareira</i> Linn.	Roots	methanol extract	Humoral antibody titre, Superoxide , Lipid peroxidation
27.	<i>Tinospora cordifolia</i>	Whole plant	Alcoholic extract	macrophage activation; lysozyme;
28.	<i>Actinidia macrosperma</i>	Whole plant	Aqueous extract	Immunomodulator, Sarcoma-180 (S180),
29.	<i>Capparis zeylanica</i>	Leaf extracts	Aerial parts	Immunomodulatory activity; Phagocytosis; Delayed hypersensitivity;
30.	<i>Prunella vulgaris</i>	Fruit-spikes	Aqueous extract	Inhibition of HIV-1 reverse transcriptase activity
31.	<i>Rhaphidophora korthalsii</i>	Leaf extracts	Methanolic extract	In vitro splenocyte cytokine (IL-2, IL-12 and IFN- γ)Determinations, In vitro splenocytes, thymocytes and bone marrow cell viability assay
32.	<i>Selaginella species</i>	Whole plant	Powdered in gum acacia	Immunomodulatory, short term toxicity
33.	<i>Couroupita guinensis</i>	Flowers	Pet. ether, Benzene, Chloroform,, Ethyl acetate, 70% ethanol and water	Allergic reaction, Haemagglutination
34.	<i>Aesculus indica</i>	Leaf	Petroleum ether and ethanol	Haemagglutination antibody
35.	<i>Capparis zeylanica</i>	Aerial part	Methanolic and aqueous extracts	Haemagglutination antibody titre
36.	<i>Aloe vera</i>	Leaves	Powder dissolved in Phosphate buffer solution	Humoral antibody response to SRBC, Cellular immune response (Foot pad reaction test)
37.	<i>Actinidia macrosperma</i>	Whole plant	Aqueous extract	AM induced antitumor

38.	<i>Allium sativum</i>	Whole plant	Hydro-alcoholic extract	Hemagglutination
39.	<i>Andrographis paniculata</i>	Whole plant	Andrographolides extract	Delayed type hypersensitivity (DTH) mouse model
40.	<i>Asparagus racemosus</i>	Root	Aqueous extract	SRBC sensitized animals
41.	<i>Baliospermum montanum</i>	Root	Aqueous extract	Nitroblue tetrazolium test
42.	<i>Boerhaavia diffusa</i>	Whole plant	Hydro-alcoholic extract	Circulating antibody titer
43.	<i>Caesalpinia bonducella</i>	Seed	Ethanollic extract	Neutrophil adhesion test, haemagglutinating antibody (HA) titre
44.	<i>Curcuma longa</i>	Balb	Hydro-alcoholic extract	Humoral antibody response to SRBC
45.	<i>Eclipta alba</i>	Whole plant	methanolic extracts	phagocytic index and antibody titer
46.	<i>Epilobium angustifolium</i>	Whole plant	Hydro-alcoholic extract	Chemotaxis, NF-kappaB activation
47.	<i>Mangifera indica</i>	Stem bark	Alcoholic extract	Humoral antibody response to SRBC
48.	<i>Picrorhiza kurroa</i>	Leaf	Ethanollic extract	Cell-mediated and humoral components
49.	<i>Salicornia herbacea</i>	Whole plant	Hydro-alcoholic extract	Phagocytic activity on opsonized
50.	<i>Withania somnifera</i>	Root	Alcoholic extract	Bone marrow cellularity
51.	<i>Azadirachta indica</i>	Leaf	Hydro acetone extract	WST-1-based cytotoxicity assay
52.	<i>Boswellia carterii</i>	Bark	Methylene chloride extract	Reagents for lymphocyte transformation assay
53.	<i>Gymnema</i>	Leaves	Water extract	Neutrophil locomotion and chemotaxis

	<i>sylvestre</i>			test
54.	<i>Tridax procumbens</i>	Aerial part	Alcoholic extract	delayed-type hypersensitivity (DTH) model
55.	<i>Tinospora cordifolia</i>	Stem	Alcoholic extract	Bone marrow cellularity and α -Esterase cells, Zinc sulphate turbidity test.
56.	<i>Clerodendrone Multiflorum</i>	Stem	Methanolic and ethyl acetate Extract	Invitro Alphaamylase inhibitory activity
57.	<i>Emblica officinalis</i>	Fruit	Alcoholic extract	Adjuvant induced arthritic (AIA)rat model
58.	<i>Heracleum persicum</i>	Whole plants	Aqueous Extract	Delayed type hypersensitivity; Haemagglutination titre
59.	<i>Morinda citrifolia</i>	Fruit	Hydro-alcoholic extract	Protein estimation, Animal-tumour system, Cytotoxicity assays
60.	<i>Nyctanthes arbor-tristis</i>	Leaf	Ethanolic extract	Delayed-type hypersensitivity (DTH) reactions, Humoral immune response
61.	<i>Centella asiatica</i>	Whole plant	Hydro-alcoholic extract	Human Lymphocyte Proliferation Assay
62.	<i>Chlorophytum borivilianum</i>	Root	Ethanolic extract	Azathioprine induced myelosuppression
63.	<i>Curculigo orchioides</i>	Root stocks	Methanolic extract	Haemagglutination antibody (HA) titre and Delayed type hypersensitivity (DTH) response
64.	<i>Randia dumetorum</i>	Fruit	Methanolic extract	Cyclophosphamide-induced myelosuppression
65.	<i>Piper longum</i>	Fruit	Alcoholic extract	Bone marrow cellularity and esterase positive cells
66.	<i>Terminalia arjuna</i>	Bark	Alcoholic extract	Inflammatory, Immunomodulatory and Antinociceptive activity.

5. CONCLUSION:

It can be concluded that studies with new immunomodulatory plants are important for the discovery of drug with less side effects, less costly, more potent and effective treatment developed for immune and their related diseases. This type of study with immunomedicinal herbs will contribute to the benefit of the populations needing herbal treatment to treat immune diseases without being used of synthetic drugs and prevent or reduces the side effect of synthetic drugs.

6. REFERENCES

1. Patil US, Jaydeokar AV, Bandawane DD, Immunomodulators: A Pharmacological Review, International Journal of Pharmacy and Pharmaceutical Sciences. 2012; 4(1):30-36.
2. Gilman et al, Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 10th edition. McGraw-Hill companies; 2001: page no. 1478
3. Katzung G. Bertram. Basic and Clinical Pharmacology. 10th edition. McGraw-Hill companies, 2007: Page no. 927.
4. Satoskar et al. Pharmacology and Pharmacotherapeutics 20th edition, Popular prakashan Private Limited; 2008: Page no. 1090.
5. Tripathi KD, Essential of Medical Pharmacology.6th edition, Jaypee Brothers Medical Publisher (P) LTD; 2008: Page no. 837.
6. Gaur Kalpesh, Kori ML, Nema RK, Comparative Screening of Immunomodulatory Activity of Hydro-alcoholic Extract of Hibiscus Rosa sinensis Linn, and Ethanolic Extract of Cleome gynandra Linn, Global Journal of Pharmacology,2009;3(2):85-89.
7. Dyaneshwar U etal, An in-vivo Study of the Immunomodulatory Activity of Coumarinolignoids from Cleome viscosa, Natural Product Communication,2007;2(9):923-926.
8. Jain Neha, Mishra RN., Immunomodulator activity of Trikatu megaExt, International Journal of Research in Pharmaceutical and Biomedical Sciences, 2011; 2(1):160-164.
9. Singh Veena. D and Mishra RN., Immunomodulator activity of megaext of triamrit, International Journal of Research in Pharmacy and Chemistry, 2011, 1(1), 62-65.
10. Kannan M., Singh Ranjit AJA, Kumar Ajith TT, Jegatheswari P. and Subburayalu S, Studies on immuno-bioactivities of Nyctanthes arbortristis(Oleaceae), African Journal of Microbiology Research,2007;1(6): 88-091.
11. Bafna Anand, Mishra Shrihari, Antioxidant and Immunomodulatory Activity of the Alkaloidal Fraction of Cissampelos pareira Linn, Scientia Pharmaceutica,. 2010; 78: 21–31.

12. Patil JK, Jalalpure SS., Hamid S. and Ahirrao RA. , In-vitro Immunomodulatory Activity of extracts of Bauhinia vareigata Linn Stem Bark on Human Neutrophils, Iranian Journal of Pharmacology & Therapeutics.2010; 9(2):42-46.
13. Vaibhav D. Aher, Wahi, Arunkumar, Pharmacological study of Tinospora cordifolia as an Immunomodulator, International Journal of Current Pharmaceutical Research,2010;2(4):52-54.
14. Korek. J, Shete RV. Kabra MP, Rachhadiya RM., Attal AR., Immunomodulatory activity of Balanite roxburghi, JPRHC Volume 3 Issue 3 Page 63-67.
15. Patil Vikas V., Bhangale Shandavi C.,Patil Vijay R., Studies on Immunomodulatory activity of Ficus carica, International Journal of Pharmacy and Pharmaceutical Sciences,2010;2(4):97-99.
16. Agrawal Surendra S, Khadase Saurabh C, Talele Gokul S, Studies on Immunomodulatory Activity of Capparis zeylanica Leaf Extracts, International Journal of Pharmaceutical Sciences and Nanotechnology,2010;3(1):887-892.
17. Patel Samir, Banji David , Banji Otilia.J.F, Patel M.M., Shah K.K.,Scrutinizing the role of aqueous extract of Trapa bispinosa as an immunomodulator in experimental animals, International Journal of Research and Pharmaceutical Sciences,2010;1(1):13-19.
18. Chandua Atul N, kumar. C Santhosh B, Bhattacharjeeb Chiranjib, debnathb Subal, Kannanc K. Kamala, Studies on Immunomodulatory activity of Aloe vera (Linn), International Journal of Applied Biology and Pharmaceutical Technology,2011;2(1):19-22.
19. Sharififar Fariba, Pournourmohammadib Shirin, Arabnejada Moslem, Rastegarianzadeha Ramin, Ranjbarana Omid and Purhemmaty Amin, Immunomodulatory Activity of Aqueous Extract of Heracleum persicum Desf. in Mice, International Journal of Pharmaceutical Research, 2009,8(4)287-292.
20. Attard E., Cuschieri A., In vitro immunomodulatory activity of various extracts of Maltese plants from the Asteraceae family, Journal of Medicinal Plants Research,2009;3(6):457-461.
21. Sharififar Fariba, Moslem Pournourmohammadib Shirin, Immunomodulatory Activity of Aqueous Extract of Achillea wilhelmsii C.Koc in Mice, Indian Journal of Experimental Biology,2009;47:668-671.
22. Shrivastav Preeti, Tinospora cordifolia (Amrita)-A miracle hearb and lifeline to many diseases, International Journal of Medicinal and Aromatic Plants,2011,1(2),57-61.
23. Jeba R.Caroline, Vaidyanathan Rama and Rameshkumar G., Immunomodulatory activity of aqueous extract of Ocimum sanctum in rat, International Journal on Pharmaceutical and Biomedical Research,2011;2(1) 33-38.

24. Ghaisas M.M. Shaikh A.S. Deshpande D.A., Evaluation of Immunomodulatory Activity of ethanolic extract of stem bark of Bauhinia variegates, International Journal of Green Pharmacy, 2009, 70-74.
25. Thakur Mayank, Bhargava Shilpi and Dixit V. K., Immunomodulatory Activity of Chlorophytum borivilianum Sant. F, eCAM 2007; 4(4)419–423.
26. Rao Bharani Shendige Eswara, Asad Mohammed, Dhamanigi Samson Sunil and Chandrakala Gowda Kallenahalli, immunomodulatory activity of methanolic extract of Morus Alba LINN. (Mulberry) Leaves, Pakistan Journal of Pharmaceutical Sciences, 2010; 23(1):63-66.
27. Chakraborty G.S. Evaluation of Immunomodulatory activity of Aesculus indica, International Journal of PharmTech Research, 2009; 1(2):132-134. Vol.1, No.2,
28. Gabhe SY , Tatke PA , Khan TA , Evaluation of the Immunomodulatory activity of the methanol extract of Ficus benghalensis roots in rats, Indian Journal of Pharmacology 200638(4):271-275.
29. Gharagozloo Marjan, Ghaderi Abbas, Immunomodulatory effect of concentrated lime juice extract on activated human mononuclear cells, Journal of Ethnopharmacology,2001;77:85-90.
30. Bafna Anand, Mishra Shrihari , Antioxidant and Immunomodulatory Activity of the Alkaloidal Fraction of Cissampelos pareira Linn., Sci Pharm,2010; 78; 21–31.
31. More P, Pai K, Immunomodulatory effects of Tinospora cordifolia (Guduchi) on macrophage activation, Biology and Medicine, 2011;3(2):134-140.
32. Lu Yin , Fan Jie, Zhao Yunpeng , Chen Shaoyuan , Zheng Xiaodong, Yin Yuanming and Fu Chengxin, Immunomodulatory activity of aqueous extract of Actinidia macrosperma, Asia Pac J Clin Nutr 2007;16 (1):261-265.
33. Agrawal S. Surendra, Khadase C. Saurabh and S.Gokul, Studies on Immunomodulatory Activity of Capparis zeylanica Leaf Extracts, International Journal of Pharmaceutical Sciences and Nanotechnology,2010;3(1):887-892.
34. Cheng Chuen-lung, Xu Hongxi, Antiviral and Immunomodulatory Properties of Prunella vulgaris, Asian Journal of Traditional Medicines, 2006; 1(1):1-5.
35. Yeap Swee Keong, Omar Rahman Abdul, Ho Wan Yong , Beh Kee Boon , Ali Manaf Abdul and Alitheen Banu Noorjahan , Immunomodulatory effect of Rhaphidophora korthalsii on mice splenocyte, thymocyte and bone marrow cell proliferation and cytokine expression, African Journal of Biotechnology,2011;10(52):10744-10751.
36. V.Gayahtri, Asha V.V. Subramoniam A.Preliminary study on the Immunomodulatory antioxidant properties of Sellaginella species.Indian Journal of Pharmacol, 2005, 37(6), 381-385.

37. Pradhan D. Panda K.P.Thripathi G. Evaluation of Immunomodulatory activity of the methanolic extract of *Couroupita guinensis* Flowers in Rats.Natural Products Radiance, 2009, 8(1):37-42.
38. Chakraborty Guno Sindhu., Patil Vikas., Kaushik Kailash N., Evaluation of immunomodulatory activity of *Aesculus indica*, Journal of Pharmacy Research;2009;2(3):385-387.
39. Agrawal Surendra S., Khadase Saurabh C., Gokul S., Studies on Immunomodulatory Activity of *Capparis zeylanica* Leaf Extracts, International Journal of Pharmaceutical Sciences and Nanotechnology; 2010;3(1):887-892.
40. Chandua et al., Studies on immunomodulatory activity of *Aloe vera* (Linn), International Journal of Applied Biology and Pharmaceutical Technology; 2011; 2(1):19-22.
41. Lu Y, Fan J, Zhao Y, Chen S, Zheng X, Yin Y, Fu C., Immunomodulatory activity of aqueous extract of *Actinidia macrosperma*, Asia Pac J Clin Nutr.; 2007;16(1):261-5.
42. Clement F, Pramod SN., Venkatesh YP., Identity of the immunomodulatory proteins from garlic (*Allium sativum*) with the major garlic lectins or agglutinins, Int Immunopharmacol; 2010; 10(3):316-24.
43. Naik Suresh R, Hule Amolkumar., Evaluation of Immunomodulatory Activity of an Extract of *Andrographolides* from *Andrographis paniculata*, Planta Med;2009; 75(8):785-791.
44. Gautam M et al., Immunomodulatory activity of *Asparagus racemosus* on systemic Th1/Th2 immunity: implications for immunoadjuvant potential, J Ethnopharmacol; 2009; 121(2):241-7.
45. Patil Alpena S., Jalalpure S. S., Wadekar R. R., Effect of *Baliospermum montanum* Root Extract on Phagocytosis by Human Neutrophils, Indian J Pharm Sci; 2009;71(1): 68–71.
46. Manu KA., Kuttan G., Immunomodulatory activities of Punarnavine, an alkaloid from *Boerhaavia diffusa*, Immunopharmacol Immunotoxicol; 2009; 31(3):377-87.
47. Shukla S., Mehta A., John J., Mehta P., Vyas SP., Shukla S., Immunomodulatory activities of the ethanolic extract of *Caesalpinia bonducella* seeds, J Ethnopharmacol;2009;125(2):252-6.
48. Antony S., Kuttan R., Kuttan G., Immunomodulatory activity of curcumin. Immunol Invest; 1999; 28(5-6):291-303.
49. Jayathirtha M G., Mishra S H., Preliminary immunomodulatory activities of methanol extracts of *Eclipta alba* and *Centella asiatica*, Phytomedicine international journal of phytotherapy and phytopharmacology;2004;11(4):361-365.
50. Schepetkin IA., Kirpotina LN., Jakiw L, Khlebnikov AI., Blaskovich CL., Jutila MA., Quinn MT., Immunomodulatory activity of oenothien B isolated from *Epilobium angustifolium*, J Immunol;2009;183(10):6754-66.

51. Makare N., Bodhankar S., Rangari V., Immunomodulatory activity of alcoholic extract of *Mangifera indica* L. in mice, *Journal of Ethnopharmacology*;2001;78(2-3):133-137.
52. Kim Mi-Hyoung., Byon Yun-Young., Eun-Ju Ko., Song Jie-Young., Yun Yeon-Sook, Shin Taekyun., Joo Hong-Gu., Immunomodulatory Activity of Ginsan, a Polysaccharide of *Panax Ginseng*, on Dendritic Cells, *Korean J Physiol Pharmacol*;2009; 13(3): 169–173.
53. Sharma M L., Rao C S, Duda P L., Immunostimulatory activity of *Picrorhiza kurroa* leaf extract, *Journal of Ethnopharmacology*;1994;41(3):185-192.
54. Im SA., Kim K., Lee CK., Immunomodulatory activity of polysaccharides isolated from *Salicornia herbacea*, *Int Immunopharmacol*; 2006; 6(9):1451-8.
55. Davis L, Kuttan G., Immunomodulatory activity of *Withania somnifera*, *Journal of Ethnopharmacology*; 2000; 71(1-2):193-200.
56. Awah FM., Uzoegwu P. N., Ifeonu P., In vitro anti-HIV and immunomodulatory potentials of *Azadirachta indica* (Meliaceae) leaf extract, *African Journal of Pharmacy and Pharmacology*;2011; 5(11):1353-1359.
57. Badria Farid A., Mikhaeil Botros R., Maatooq Galal T., M. A. Amer Mohamed., Immunomodulatory Triterpenoids from the Oleogum Resin of *Boswellia carterii* Birdwood, *Z. Naturforsch*;2003; 58c: 505-516.
58. Malik Jitender K, Manvi Dr.F V., Nanjwade Dr.B.K., Alagawadi Dr. K.R., Singh Sanjiv., Immunomodulatory activity of *gymnema sylvestre* Leaves on in-vitro human neutrophils, *Journal of Pharmacy Research*;2009;2(8):1284-1286.
59. Agarwal S., Khadase S., Talele G., Bioactive immunomodulatory fraction from *Tridax procumbens*, *Asian journal of biological sciences*;2010; 3(3):120-127.
60. Aher Vaibhav D., Wahi Arunkumar., Pharmacological study of *Tinospora cordifolia* as an immunomodulator, *International Journal of Current Pharmaceutical Research*;2010;2(4):52-54.
61. Sneha J A., Chaudhari Sanjay., Alphaamylaseinhibitory and Hypoglycemic Activity Of *Clerodendron Multiflorum* Linn stems. *Asian J Pharm Clin Res*; 2011; 4(2):99-102
62. Madhuri S., Pandey Govind., Verma Karuna S., Antioxidant, Immunomodulatory and Anticancer activities of *Emblica officinalis*: An Overview, *International research Journal of Pharmacy*; 2011;2(8):38-42.
63. Sharififar et al. Immunomodulatory Activity of Aqueous Extract of *Heracleum persicum* Desf. In Mice, *Iranian Journal of Pharmaceutical Research*; 2009; 8(4):287-292.

64. Hirazumi Anne., Furusawa Eiichi., An Immunomodulatory Polysaccharide-Rich Substance from the Fruit Juice of *Morinda citrifolia* (Noni) with Antitumour Activity, *Phytother. Res*; 1999; 13:380–387.
65. Kannan M., Singh AJA. Ranjit., Kumar TT. Ajith., Jegatheswari P., Subburayalu S., Studies on immuno-bioactivities of *Nyctanthes arbortristis* (Oleaceae), *African Journal of Microbiology Research*; 2007;1 (6):088-091.
66. Khanittha Punturee., Christopher P Wild., Watchara Kasinrerk., Usanee Vinitketkumnuen., Immunomodulatory Activities of *Centella asiatica* and *Rhinacanthus nasutus* Extracts, *Asian Pacific Journal of Cancer Prevention*; 2005;6: 396-400.
67. Thakur Mayank., Bhargava Shilpi., Dixit V. K., Immunomodulatory Activity of *Chlorophytum borivilianum* Sant. F, *CAM*; 2007;4(4): 419–423.
68. Rathod Devyani B., Lahiri Suman., Yadav Gunvat K., Shah Mamta B., Immunomodulatory and Antioxidant Activity of *Curculigo orchioides* Gaertn, *International Journal of PharmTech Research*; 2010;2(2):1197-1203,
69. Satpute K L., Jadhav M M., Karodi R S., Katare Y S., Patil M J., Rub Rukhsana., Bafna AR, Immunomodulatory activity of fruits of *Randia dumetorum* Lamk, *Journal of Pharmacognosy and Phytotherapy* ; 2009;1.
70. Sunila E S., Kuttan G., Immunomodulatory and antitumor activity of *Piper longum* Linn. And piperine, *Journal of Ethnopharmacology*; 2004; 90:339–346.
71. Bachhawat. Ankita J, Shihabudeen Mohamed Sham and Kavitha Thirumurugan, Screening of Fifteen Indian Ayurvedic Plants for Alpha-glucosidase Inhibitory Activity and Enzyme Kinetics, *International Journal of Pharmacy and Pharmaceutical Sciences*;2011;3(4)-267-274.