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Research Article

FORMULATION DEVELOPMENT FOR TREATMENT AND MANAGEMENT OF HIV-AIDS

***AMOL B. CHOUDHARI[1], VINOD D. RANGARI[1], VAIBHAV M. DARVEKAR[2]**

[1]J. L. Chaturvedi College of Pharmacy, Electronic zone, MIDC, Hingna road, Nagpur, [2]Patal Dhamal Wadhavani College of Pharmacy, Dhamangoan road, Yavatmal Email: amolchoudhari5@rediffmail.com

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ABSTRACT

The formulations contains a plants which have a potent immunomodulator activity namely *Andrographis paniculata, Momardica charantia, Phyllanthus niruri, Terminallia chebula, Glycyrrhiza glabra and Punica granatum.* It has good impact in the treatment and management of HIV-AIDS because these formulations not only treat disease but also enhance the body vitality and immunity. The humoral and cell-mediated immune response was observed through Delayed Type Hypersensitivity (DTH) and Macrophages Phagocytosis by Carbon clearance test. These formulation have studied on Swiss albino mice in normal and suppressed immune system by Cyclophosphamide (CP) in three different doses, it shown maximum decrease in foot paw oedema from 2.15mm to 0.35 mm, similarly maximum increase in the WBC and Platelet count up to 10.4±0.07 thousand / mm^3 and 96142 ±142 in respectively. Similarly these formulations have shown maximum increase in mean Phagocytic index in carbon clearance test in normal and suppressed condition up to 0.0190 in (F1) and 0.0151 and it shown significant statistical analysis $P<0.001$.

Keywords: HIV-AIDS, immunity, immune response, Humoral and cell mediated immunity.

INTRODUCTION

HIV virus attacks and impairs the body's natural defense system against disease and infection. The underlying problem identified as a severe depression of immune system that is cause by the nearly complete lack of one class of T-lymphocyte, which are called helper cell that are needed for initiating and maintaining many immune responses.[1, 2.]

The world health organization estimated that, in the year 2007, the cumulative total infected were 33.2 millions. Numbers of people newly infected in each year are 2.5 million and 2.1 million people dying by AIDS in each year. Every day over 6800 persons become infected with HIV and over 5700 persons dying from AIDS.[3] So there is a need to control the death of people and this formulation have negligible side effect and have potential to strengthen immune system and suppressed the virus so it cannot detect in the blood and it prolong the life of human beings.

MATERIAL AND METHODS

Selection of the crude drugs have been done after the extensive review of the literature taking into consideration the specific activity of active constituent present in the medicinal plant. Some of the crude drugs have also been added for their immunostimulant or tonic effect, or simply as a bioavailability enhancer[4,5,6].

The medicinal plants selected are given in table 1.

Table 1: The medicinal plants used in formulations

Sr No.	Name of plant	Plant part used	Active constituents	Activity
1	*Andrographis paniculata*	Aerial part	Andrographolide, bicyclic diterpenoid lactones and kalmeghin	Immunostimulant Inhabited syncytium formation, Anti HIV activity.
2	*Momardica charantia*	Seeds	MAP 30 (Momardica Anti HIV protein), Alpha momarcharin, MRK 29 (RIP), momardicosides	RT activity, inhibits HIV-1 infection, syncytium formation, herpes simplex virus, HIV-1 integrase, Beta glucosidase inhibitory.
3	*Phyllanthus niruri*	Whole plant	Phyllanthin, Hypophyllanthin, Rapendusinic acid A monosodium salt (RA)	HIV-1 inhibitor, Inhibited HIV-1 RT ,
4	*Terminallia chebula*	Fruit	Gallic acid, Ellagic acid, Chebulic acid, Galloyl glucoses	HIV-1 Integrase, Inhibitor of HIV-1 Protease
5	*Glycyrrhiza glabra*	Roots	Glycyrrhizin	Anti HIV activity, Inhibite HIV induce plaque formation.
6	*Punica granatum*	Bark	Punicalin and Punicoretin	HIV-1 RT activity.

Preparation of herbal formulation

The quantity of extracts required for formulating herbal drug formulation (Table 2) are calculated on the basis of human dose of powder form and percentage practical yield of respective crude drugs. Three formulations are prepared using 2% w/v gum tragacanth as suspending agent and considered as Lower dose, Average dose and Higher dose formulation[7].

Table 2: Quantity of plant extracts used for preparing herbal formulations F1, F2, F3.

Sr. No.	Extract Name	Quantity of Extract mg/kg(F1)	Quantity of Extract mg/kg (F2)	Quantity of Extract mg/kg (F3)
1	*Andrographis paniculata*	155	312	467
2	*Momardica charantia*	130	392	654
3	*Phyllanthus niruri*	550	1100	1650
4	*Terminallia chebula*	425	851	1277
5	*Glycyrrhiza glabra*	524	1049	1573
6	*Punica granatum*	513	1026	1539

Animal

The experimental protocol was submitted and approved by Institutional Ethical Committee (IAEC No. 648/02/C/CPCSEA), J. L. C. College pharmacy, Nagpur.

Albino mice (Swiss) of either sex weighing between 20-25 g were employed in this investigation. They were housed under standard conditions of temperature 22^{0}C ($\pm$ 3^{0}C) humidity 35 % to 60 %, and light (12:12 hr light/dark cycle) in polypropylene mice cage.

Material

Cyclophosphamide (High-media.) was used as standard immunosuppressant.

Carbon ink suspension- Pelikan 4001, Germany black ink was diluted eight times in a dose of 10 μl/gm body weight of mice (Bafana, A., 2004). Antigenic material - The sheep RBCs (SRBCs) were used as antigenic material. The sheep blood was withdrawn from external jugular vein of sheep (Government Vetneiry college, Nagpur). It was mixed in 1:1 proportion in Alsever's solution & stored at 2^0 to 8^{0}C in refrigerator.

Procedure

Swiss albino mice (HA strain) weighing between 20-30gm were brought.

All mice were marked with picric acid and randomly divided into eight groups, each group comprising of six animals. Weight of individual mice was taken on electrical signal pan balance and numbering was done to each mice.

Preparation of SRBC suspension

Sheep blood was collected from Veterinary College in Alsevar's solution (1:1) and centrifuged at 2500-3000 rpm for 10 minutes. Supernatant was removed with Pasture pipette, and packed SRBCs were washed thrice with sterile Alsevar's solution. The resulting SRBCs were suspended in sterile Alsevar's solution to obtain a cell density of 10^6 SRBCs/mm^3, using improved Neubaur chamber[8].

Preparation of suspension of dose of herbal formulation

Three formulations were prepared considering Lower (F1), Average (F2), and Higher (F3) in distilled water using 2% w/v gum tragacanth as a suspending agent.

Preparation of solution of Cyclophosphamide

30 mg / kg solution of cyclophosphamide was prepared in sterile normal saline[8].

Pharmacological study

Toxicity Study

Toxicity studies of Herbal drug formulations were carried out in Swiss albino mice according to OECD guideline 423. Dose ranging between 500, 1000, 2000, 4000 and 5000 mg/kg of body wt. of formulation were administered stepwise to the mice according to their weights. The mice were observed individually after at least once during the first 30 minutes, periodically during the first 24 hrs, there was no mortality found till dose of 5000 mg/kg body weight in formulation F1, F2 and F3 [8].

Delayed type hypersensitivity model

Procedure

On day zero Cyclophosphamide (CP) 30 mg/kg was administrated IP to the animal of group v, vi, vii and viii 2 hrs before sensitizing with 1x 10^6 SRBCs, as antigen, through IP route.

All the group were treated as per the table 3 for next five days, i.e. day 1 to day 5. All the animals were maintained on same diet and environment throughout the duration of the experiment. Administration of extract was done by oral route using animal feeding needle and 1 ml syringe.

On day 5 the left hind paw thickness was measured for all the animals. The animals were then challenged with the same antigen SRBCs, 1x10^6 in 0.1 ml, in the left hind paw by SC route. The Paw thickness measurement was again done at interval of 24, 48, 72 and 96 hrs from the challenge.

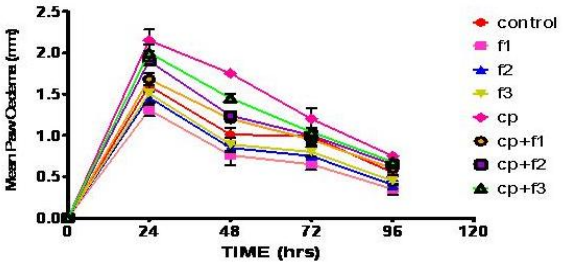
On the day 10 all mice were anaesthetized by putting in an anesthetic ether chamber. Blood was collected from the retro obituary vein for WBC and Total Platelet Count[8].

Table 3: Experimental design of Delayed type hypersensitivity in mice

Day 0	Group V- VIII	30 mg/kg of CP by IP route, 2 hrs before Sensitization
	Group I-VIII	Sensitization with 1x10^6 SRBCs by IP route
Day 1	Group I and V	2% w/v gum tragacanth
To	Group II and VI	F1: Lower dose
Day 5	Group III and VII	F2: Average dose
	Group IV and VIII	F2: Higher dose
Day 5	Group I- VIII	Measurement of Paw thickness
		Challenge with 1x10^6 SRBCs by SC route
Day 6 to Day 9	Group I- VIII	Measurement of Paw thickness
Day 10	Group I- VIII	Collection of Blood for WBC and Total Platelet Count

Table 4: Effect of Prepared Herbal Formulations on Mean Foot Pad Oedema in DTH model

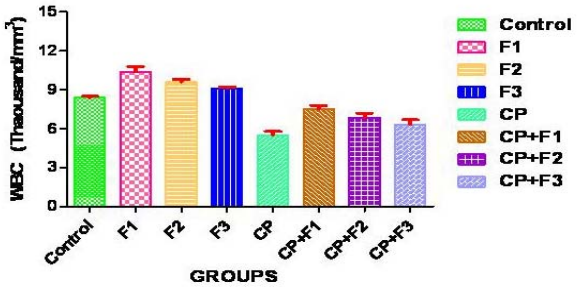
Gp. No.	Gp. Description	Mean Foot Paw Oedema			
		24 hrs	48hrs	72 hrs	96hrs
I.	Control	1.6 $\pm$ 0.07*	1.01 $\pm$ 0.08*	0.99 $\pm$ 0.08 *	0.55 $\pm$ 0.55*
II.	F1	1.31 $\pm$ 0.08*	0.76 $\pm$ 0.12*	0.65 $\pm$ 0.07*	0.35 $\pm$ 0.07*
III.	F2	1.46 $\pm$ 0.09	0.85 $\pm$ 0.05	0.75 $\pm$ 0.03	0.40 $\pm$ 0.05
IV.	F3	1.51 $\pm$ 0.14	0.89 $\pm$ 0.08	0.80 $\pm$ 0.06	0.45 $\pm$ 0.05
V.	CP	2.15 $\pm$ 0.13*	1.75 $\pm$ 0.02*	1.20 $\pm$ 0.13*	0.75 $\pm$ 0.04*
VI.	CP+F1	1.68 $\pm$ 0.07*	1.20 $\pm$ 0.02*	0.95 $\pm$ 0.07*	0.60 $\pm$ 0.08*
VII.	CP+F2	1.90 $\pm$ 0.05	1.24 $\pm$ 0.05	1.0 $\pm$ 0.07	0.65 $\pm$ 0.04
VIII.	CP+F3	2.0 $\pm$ 0.10	1.45 $\pm$ 0.05	1.05 $\pm$ 0.05	0.68 $\pm$ 0.04



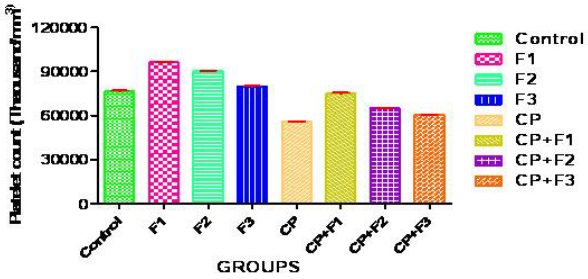
Graph 1: Effect of Prepared Formulation On Mean Foot Paw Oedema in DTH Model.

Table 5: Effect of prepared formulation on leukocyte and platelet count in DTH model

Sr. No.	Groups	Haematological Parameters	
		Leukocyte Count (Thousand/mm³)	Platelet Count (Thousand/mm³)
I.	Control	8.4 ± 0.1*	76680 ± 220*
II.	F1	10.4 ± 0.4*	96142 ± 142*
III.	F2	9.6 ± 0.2	90292 ± 170
IV.	F3	9.1 ± 0.1	79831 ± 190
V.	CP	5.52 ± 0.27*	55669 ± 310*
VI.	CP+F1	7.52 ± 0.27*	75167 ± 250*
VII.	CP+F2	6.87± 0.32	65038 ± 275
VIII.	CP+F3	6.32± 0.37	60391 ± 290



Graph 2: Effect of Prepared Formulation on WBC Count in DTH Model.

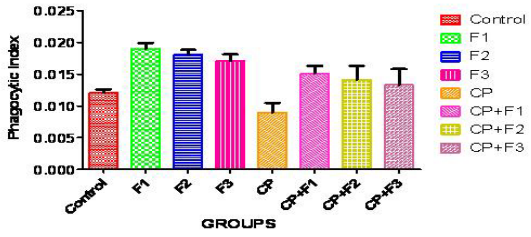


Graph 3: Effect of Prepared Formulation on Platelet Count in DTH Model.

Experimental Design: Carbon Clearance Test in mice

Table 6: Effect of Prepared Herbal Formulations on Microphage Phagocytosis by Carbon Clearance Method

Sr. No.	Group Description	Mean Phagocytic Index
I.	Control	0.0121 ± 0.0005*
II.	F1	0.0190 ± 0.0009*
III.	F2	0.0181 ± 0.0007
IV.	F3	0.0171 ± 0.0010
V.	CP	0.0090 ± 0.0015*
VI.	CP + F1	0.0151 ± 0.0012*
VII.	CP + F2	0.0141 ± 0.0022
VIII.	CP + F3	0.0133 ± 0.0025



Graph 4: Effect of Prepared Formulation on Macrophage Phagocytosis by Carbon Clearence Test.

RESULTS AND DISCUSSION

The formulations have shown immunostimulant activity in DTH model, when used alone and also a significant immunostimulant activity in the animals whose immunity was suppressed using cyclophosphamide. The phagocytic activity was also found to increase in Carbon Clearance test when the formulation used alone as well as in the suppressed immune system.

The crude drugs viz. namely *Andrographis paniculata, Momardica charantia, Phyllanthus niruri, Terminallia chebula, Glycyrrhiza glabra* and *Punica granatum* which have been collected and authenticated.

The crude drugs were shredded and powder to a coarse powder consistency, which was subjected to extraction by using suitable solvents. The solvent and method of extraction was selected such that the resultant extract contains the active constituents. The extract obtained were concentrated and dried in desiccator or by sun draying process.

All the individual dried extracts were checked for their active ingredients by proximate chemical analysis. It showed that all extract contains required active constituent.

All the extracts were subjected to chromatographic evaluation to check possible number of component in respective extracts using

thin layer chromatography technique. The extracts of *Andrographis paniculata* was compared with standard samples of *A. paniculata* by their R_f values. For the design and preparation of an effective immunostimulant herbal formulation, all the individual dried extracts were mixed in a requisite amount and 2% w/v Gum tragacanth was added to the formulation as a suspending agent. The quantities of extracts were calculated on the basis of human dose of powder form of drugs and their respective percentage yield.

The prepared formulation were subjected to toxicity study and were found to be safe up to daily dose of 5000 mg/kg of body wt./mice with no toxic reaction being observed.

The immunostimulant activity of the prepared herbal formulations was studied using delayed type hypersensitivity (DTH) model and carbon clearance test in mice. The results obtained from the DTH model have indicated significant decrease in the mean foot paw oedema, after challenging with 10^6 SRBC, when plotted against time. The CP receiving group has shown maximum oedema of 2.15 ± 0.13 mm after 24 hrs, of challenge, deceasing to 0.75 ± 0.04 mm after 96 hrs. The group receiving F_1 have shown significantly lower values of mean foot paw oedema as compared with the controlled group, indicating a strong immunostimulant effect of formulation F1 than that F2 and F3. The group receiving CP + F1 has also shown marked decreased in the mean foot paw oedema as compared with the CP receiving group confirming the immunostimulant effect of the formulations in the suppressed immune system. Results of WBC and Platelet counts for the animals receiving F1, F2 and F3 have also shown significant increasing in count as compared to the control group animals. The results of CP + F1, CP + F2 and CP+F3 groups have shown a marked increase in the Platelet counts respectively, as compared with the CP treated group. This clearly indicates that the formulation has a strong immunostimulant activity on the suppressed immune system. The result obtained during the present investigation showed that there is significant antibody production in response to SRBCs in formulation F1.

The Phagocytic Index of the above formulations was studied by using Carbon Clearance test. The results obtained from the Carbon Clearance test have indicated significant increase in Phagocytic Index when plotted against time. The group receiving CP has shown minimum Phagocytic Index (O.0090 ± 0.0015) after 15 min. the group receiving F1 have significant increase in the Phagocytic Index when compared with the control group indicating immunostimulant activity. The groups receiving CP + F1, CP +F2 and CP+F3 have also shown marked increase in the Phagocytic Index when compared with group receiving CP. This indicates the immunostimulant activity of the formulations in suppressed immune system.

The increase in carbon clearance index reflects the enhancement of phagocytic function of mononuclear macrophages and non-specific immunity. Phagocytosis by macrophages is important against pathogenic microorganism and its effectiveness is markedly enhanced by opsonisation of parasite with antibodies and complement C_3 b leading to more rapid clearance of parasite from blood.

CONCLUSION

The herbal formulation designed and developed as potential immunostimulant has been found to be safe up to a very high dose of 5000 mg/kg/day/mice during toxicity studies. The formulations have shown immunostimulant activity in DTH model, when used alone and also a significant immunostimulant activity in the animals whose immunity was suppressed using cyclophosphamide. The phagocytic activity was also found to increase in Carbon Clearance test when the formulation used alone as well as in the suppressed immune system. Thus the formulations under study have the ability to recover the suppressed immune system. There it can be used for the treatment and management of AIDS and AIDS related complex in which the immune system is suppressed or deranged by the HIV-infection.

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