FORMULATION AND EVALUATION OF TURMERIC GEL FOR ANTI-INFLAMMATORY ACTIVITY

Archana G. L[1],J.Ashwini[2]Kalavati Jambigi[3]N. Ramasamy[4],J. Jeya Ananthi[5], Konatham Teja Kumar Reddy[6*], S.Shanmukha Raju[7]

[1]Assistant Professor, University College of Pharmaceutical Sciences, Satavahana University, Karimnagar, Telangana, India 505001

[2]Assistant Professor, University College of Pharmaceutical Sciences, Satavahana University, Karimnagar, Telangana, India 505001

[3]Assistant Professor,Department of pharmacology,K L E College Of Pharmacy,2nd Block, Rajajinagar, Bengaluru, Karnataka 560010

[4]Assistant Professor, Department of Pharmacognosy, Arulmigu Kalasalingam College of Pharmacy, Krishnankoil- 626126.

[5]Professor, Department of Pharmaceutics Arulmigu Kalasalingam College of Pharmacy, Krishnankoil-

[6*] University college of Technology, Osmania University Main Rd, Amberpet, Hyderabad, Telangana

[7]Department of Pharmacy, University college of Technology, Osmania University Main Rd, Amberpet, Hyderabad, Telangana 500007

Corresponding Author Email : teja.konatham1704@gmail.com

ABSTRACT

Topical delivery can be defined as the application of a drug containing formulation to the skin to directly treat cutaneous disorders (e.g., acne) or the cutaneous manifestations of a general disease (e.g., psoriasis) with the intent of containing the pharmacological or other effect of the drug to the surface of the skin or within the skin. Semi-solid formulation in all their diversity dominate the system for topical delivery, but foams, spray, medicated powders, solutions, as well as medicated adhesive systems are also in use.The aim of the present investigation was to develop and study topical gel delivery of curcumin Curcuma longa (Turmeric) isa popular and widely used Indian rhizomatous medicinal plant from the family Zingiberaceae. Curcumin, Desmethoxycurcumin (DMC), and Bisdemethoxycurcumin (BDMC) are the constituents of the turmeric and are collectively known as curcuminoids for its anti-inflammatory effects. Carbopol 934P and Carbapol 940p (CRB). All the prepared gel formulations were evaluated for various properties such as compatibility, drug content, viscosity, spredability, invitro diffusion studies and anti-inflammatory effect..Topical gel formulations were free of skin irritation

Keywords : curcumin, carbopol (934,) carbopol (940), anti-inflammatory

DOI Number: 10.14704/NQ.2022.20.12.NQ77085 **NeuroQuantology2022;20(12): 1038-1047**

INTRODUCTION

The goal of any drug delivery system is to provide a therapeutic amount of drug to the proper site in the body to promptly achieve and then maintain the desired drug concentrations. The route of administration has a significant impact on the therapeutic outcome of a drug. Skin is one of the most readily accessible organs on human body for topical administration and is main route of topical drug delivery system. Topical delivery can be defined as the application of a drug containing formulation to the skin to directly treat cutaneous disorders (e.g., acne) or the cutaneous manifestations of a

general disease (e.g., psoriasis) with the intent of containing the pharmacological or other effect of the drug to the surface of the skin or within the skin. Semi-solid formulation in all their diversitydominatethe system for topical delivery, but foams, spray, medicated powders, solutions, as well as medicated adhesive systems are also in use.

Gel:

A gel is a solid or semisolid system of at least two constituents, consisting of a condensed mass enclosing and interpenetrated by a liquid. Gels and jellies are composed of small amount of solids dispersed in relatively large amount of liquid, yet they posses more solid-like than liquidlike character. The characteristic of gel and jelly is the presence of some form of cutaneous structure, which provides solid-like properties.

Gels have better potential as a vehicle to administer drug topically in comparison to the ointment because they are non-sticky, requires low energy during formulation.

Gel consists of a natural or synthetic polymer forming a three-dimensional matrix throughout a dispersion medium or hydrophilic liquid. After application, the liquid evaporates leaving the drug entrapped in a thin film of the gel–forming matrix physically covering the skin.

MATERIALS:

PREPARATION OF EXTRACT:

100 grams of turmeric powder was soaked in 500ml of methanol in a conical flask covered with aluminium foil. This process was in duplicates. This mixture was allowed to macerate for 4-5 days with interval shaking. After maceration the mixture was subjected to filtration. The filtration was collected in china dishes upto 60%. This was allowed to evaporate for a week until extract was obtained.

POLYMERS: Carbapol 934, Carbapol 940

SOLVENTS: Triethanolamine, Methanol, Distilled Water.

PRESERVATIVES: Sodium benzoate.

PREPARATION OF BUFFER PHOSPHATE BUFFER, PH 7.2

Ingredients	**Gms / Litre**
Potassium dihydrogen phosphate	34.000
Distilled water	500.000

The pH is adjusted to 7.2 with 1N NaOH and the volume made to 1000 ml with distilled water.

PHYTOCHEMICAL SCREENING:

Phytochemicals are bioactive non-nutritive plant chemicals that have protective or disease preventive properties and they act as antioxidants, enzymes stimulant, anti-bacterial agents, anti-cancer agents as well as possessing hormonal action. Most plants that contain high proportion of these phytochemicals are often referred to as medicinal plants.

Turmeric is the rootstalk of a tropical plant in ginger family and it is botanically known as *Curcuma longa*. The root has been in use for thousands of years in India and China as a spice, and medicine for conditions including heartburn, diarrhea, stomach bloating, colds, fibromyalgia and depression. It is sometimes applied on the skin for ringworm and infected wounds as it is said to have anti-bacterial properties. It is the spice responsible for the yellow color of curry. Main component of the spice is a substance called curcumin, which has potential healing properties as a result of its powerful anti-inflammatory and antioxidant properties. The presence of curcumin in turmeric has made it useful in preventing and curing some inflammatory conditions such as

tendonitis and arthritis, disinfecting cuts and burns, preventing prostrate and breast cancer and stop the growth of existing ones, reducing the risk of childhood leukemia.

QUALITATIVEPHYTOCHEMICALSCREENING OFTURMERIC EXTRACTS

Phytochemical screening was carried out inMethanol extracts of turmeric extracts using standard procedures.

Test for tannins: 0.5 g of plant extract was mixed with 2mL of water and heated on water bath. The mixture was filtered and 1mL of 10% $FeCl_3$ solution was added to the filtrate. A blue-black solution indicates the presence of tannin.

Test for flavonoids:5 mL of distilled water and about 0.2 g of plant extract were mixed thoroughly. And 1 mL of 1% $AlCl_3$ solution was added and shaken. A light-yellow precipitate indicates the presence of flavonoids.

Test for phenols: About 0.5 g of plant extract was added to 1 mL of 10% $FeCl_3$ solution. A deep bluish green coloration was an indication for the presence of phenols.

Test for saponins: About 0.2 g of plant extract was shaken with 4 mL of distilled water and then heated to boil on a water bath. Appearance of creamy miss of small bubbles (Frothing) shows the presence of saponins.

Test for reducing sugars:2 mL of distilled water and 0.2 g of plant extract were mixed together and thoroughly shaken in a test tube. 1 mL each of Fehling solution A and B were added to the mixture. A brick-red precipitate at the bottom of the test tube confirms the presence of reducing sugar

Test for resins: 0.2 g of plant extract and 2 mL of acetic anhydride were mixed together. A drop of concentrated sulphuric acid was added to the mixture. A purple or violet colour indicate the presence of resins.

Test for chalcone: 0.2 g of plant extract and 2 mLof 1% ammonium hydroxide were mixed together. The appearance of reddish colour shows the presence of chalcone.

Test for glycoside: 0.2 g of plant extract and 2.5 mL of dilute sulphuric acid were mixed together and boiled for 15 minutes, cooled and neutralized with 5 mL each of Fehling solution A and B. The formation of brick red precipitate confirmed glycoside.

Test for volatileoil: 0.2 g of plant extract and 2 mL of ethanol were mixed together and few drops of ferric chloride solution was added. A green colouration indicates volatile oil.

Test for amino acid (protein): 0.2 g of plant extract and 5 mL of distilled water were mixed together and left for 3 h. The mixture was later filtered. To 2 mL of the filtrate, 0.1 mL Millon's reagent was added. A yellow precipitate indicates the presence of protein (amino acid)

Test for phlobatannins:0.2 g of plant extract and 2 mL of 10% aqueous hydrochloric acid solution were mixed together and boiled. A deposition of red precipitate indicates the presence of phlobatannins.

Test for anthraquinones:0.2 g of plant extract and 5 mL of chloroform were mixed, shaken together for 5 minutes. The mixture was filtered. 2.5 mL of 10% ammonium hydroxide was added to the filtrate. A bright pink, red or violet colour at the upper layer indicates free anthraquinones.

Test for steroids (Salkowski test): 0.2 g of plant extract and 2 mL of chloroform were added together, 2 mL of concentrated sulphuric acid was added to form a layer. The formation of a violet/blue/green/reddish-brown ring at the interface indicates the presence of steroidal ring.

IN VITRO ANTI-INFLAMMATORY ACTIVITY (HRBC METHOD)

Blood was collected from healthy human volunteer and mixed with equal volume of Alsvers solution. This blood was centrifuged at 3000 rpm. Packed cells were washed with isosaline and 10% suspension was made. Various concentrates of extracts were prepared using distilled water and to each concentration 1ml phosphate buffer, 2ml hypo saline, 0.5ml HRBC Suspension was added and subjected to incubation at 37^0C for 30 minutes. After incubation the mixture was centrifuged at 3000rpm for 20minutes and the hemoglobin content of supernatant solution was estimated spectrophotometrically at 424nm[9].

% of hemolysis = (optical density of test /optical density of control) X 100

% of protection = 100- (optical density of test / optical density of control) X 100

FORMULATION:

INGREDIENTS	F1	F2	F3	F4
Turmeric extract	1gram(2%)	1 gram(2%)	1gram(2%)	1gram(2%)
Carbopol (934)	1.5grams(3%)	-	2grams(4%)	-
Carbopol (940)	-	1.5grams(3%)	-	2grams(4%)
Methanol	15ml	15ml	15ml	15ml
Triethanolamine	q.s	q.s	q.s	q.s
Sodium benzoate	q.s	q.s	q.s	q.s
Distilled water	Upto 50ml	Upto50ml	Upto50ml	Upto50ml

Turmeric gel was prepared by using dispersion method

The required amount of carbopol was taken and sprinkled in 3 mL of water in a beaker. The beaker was kept aside for 15 minutes for the carbopol to swell. Later, a weighted amount of methanol and the turmeric extract was added to the beaker and stirred Alternatively, the slurry of turmeric extract in methanol can also be prepared and can be incorporated in the beaker containing carbopol mixture The above mixture was sonicated for 10-15 minutes using a bath sonicator. Once the turmeric powder was evenly dispersed, Triethanolamine was added to adjust the pH till 7. Sodium benzoate was added to it and lastly, a sufficient quantity of distilled water was added to get a turmeric gel.

EVALUATION

Physical appearance- The physical appearance of the formulation was checked visually which comprised

Color - The color of the formulations was checked out against white background.

Consistency-The consistency was checked by applying on skin.

Feel on the skin: This was observed by applying on the skin.[1]

pH:

pH of the formulated gel was determined by using pH meter. In this method, gel was dispersed in purified water. The electrode was washed with double distilled water, dried by tissue paper and calibrated before use with standard buffer solution at 4.0, 7.0,9.0. The pH measurements were done in triplicate and average values were calculated[2].

HOMOGENEITY:

Formulations were tested for homogeneity by visual inspection after the formulations have been set in the container. They were tested for their appearance and presence of any aggregates[3]

VISCOSITY:

Viscosity of gel was determined by using Brookfield rotational viscometer at 5,10,20,30 and50 rpm. Each reading was taken after equilibrium of the sample at the end of two minutes. The samples were repeated three times[4]

SPREADABILITY:

The spreadability studies were carried out using 1gm of the gel on the butter paper. This was then placed between two parallel tiles with an upper plate bearing a weight of 1 kg. The spreading diameter of the gel was recorded as spreadability. The average diameter of the circle after the spreading of the gel was determined[5]

DRUG CONTENT:

Drug content of the gel formulations was determinedby dissolving an accurately weighed quantity of gel (about100 mg) in about 50 mL of pH 7.2 phosphate buffer containing 20% v/v ethanol. These solutions were quantitatively transferred to volumetric flasks and appropriate dilutions were made with the same buffer solution. The resulting solutions were then filtered through 0.45 membrane filters before subjecting the solutions to spectrophotometric analysis for CUR at λmax of 424 nm. Drugcontent was calculated from the linear regression equationobtained from the calibration data[6].

STANDARD GRAPH:

Curcumin 10mg was accurately weighed and transferred in a 100ml volumetric flask. Methanol was added upto the mark to obtain a concentration of 100µg/ml of Stock solution. From Stock solution 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 ml of solutions were withdrawn and diluted to 10ml with methanol to obtain concentrations of 1, 2, 3, 4, 5, 6, 7µg/ml, respectively[7]

The standard calibration curve of curcumin was obtained by measuring the absorbance of curcumin solution in concentration range (1-7µg/ml) prepared from stock solutions in methanol at 424 nm in triplicate. Calibration curve of curcumin was then plotted with absorbance on y-axis and curcumin concentration on x-axis.

IN VITRO DIFFUSION STUDY:

The diffusion studies of the prepared gels can be carried out by using cellophane membrane. Gel sample was taken in cellophane membrane and the diffusion studies were carried out at 37 ± 1° using 250 ml of phosphate buffer (pH 7.4) as the dissolution medium. Five milliliters of each sample was withdrawn periodically at 1, 2, 3, 4, 5, 6, 7 and 8 h and each sample was replaced with equal volume of fresh dissolution medium. Then the samples were analyzed for the drug content by using phosphate buffer as blank[8]

IN VITRO ANTI-INFLAMMATORY ACTIVITY (HRBC METHOD)

Blood was collected from healthy human volunteer and mixed with equal volume of Alsvers solution. This blood was centrifuged at 3000 rpm. Packed cells were washed with iso

saline and 10% suspension was made. Various concentrates of extracts were prepared using distilled water and to each concentration 1ml phosphate buffer, 2ml hypo saline, 0.5ml HRBC Suspension was added and subjected to incubation at 37^0C For 30 minutes. After incubation the mixture was centrifuged at 3000rpm for 20minutes and the hemoglobin content of supernatant solution was estimated spectrophotometrically at 424nm[9].

% of hemolysis = (optical density of test /optical density of control) X 100

% of protection = 100- (optical density of test / optical density of control) X 100

COMPOSITION:

Blank:

Phosphate buffer - 1ml,Hypo saline -2ml ,Normal saline -0.5ml .

Control:

Phosphate buffer -1 ml, Hypo saline -2ml, HRBC Suspension-0.5ml.

Standard drug:

Phosphate buffer - 1ml, Hyposaline - 2ml Standard drug - 1ml(50- 250mg/ml) , HRBC Suspension - 0.5ml.

Test:

Phosphate buffer – 1ml, Hyposaline - 2ml, Plant extract – 1ml, HRBC Suspension – 0.5ml.

RESULT AND DISCUSSION:

PHYTOCHEMICAL SCREENING:

CONSTITUENTS	**SOLVENT-EXTRACTS OF TURMERIC**
	METHANOL
Flavonoids	**+**
Phenol	**+**
Tannin	**–**
Saponin	**–**
Antraquinone	**+**
Volatile oil	**+**
Steroid	**–**
Glycoside	**–**
Reducing sugar	**+**
Phlobatannins	**+**
Amino acid	**+**
Resin	**–**
Acid test	**–**
Chalcone	**+**

INVITRO ANTIINFLAMMATORY STUDY(HRBC METHOD):

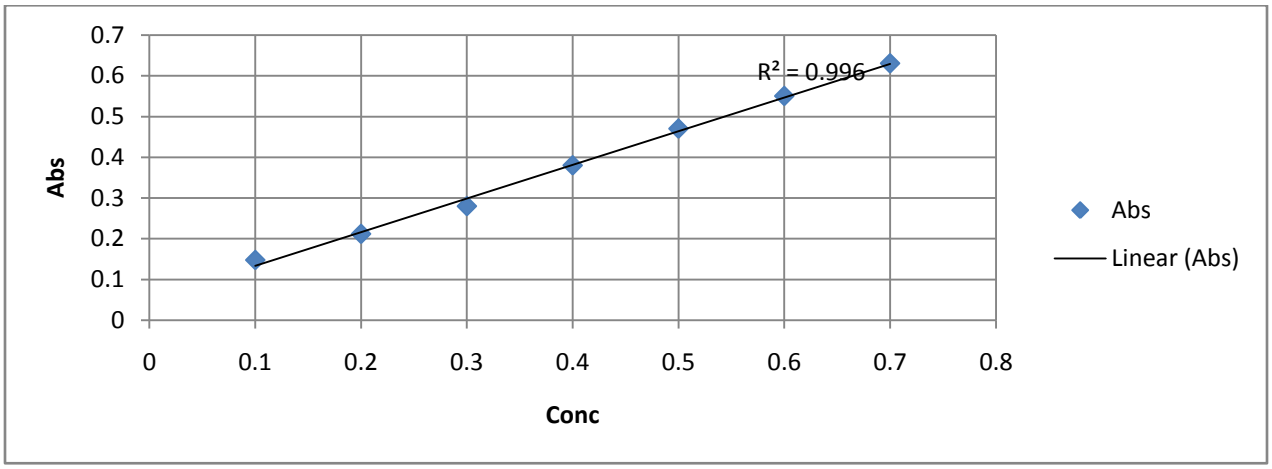
- % of hemolysis = (optical density of test /optical density of control) X 100
  =(0.011/0.04)X 100 =27.5
- % of protection = 100- (optical density of test / optical density of control) X 100
  = 100-(0.011/0.04)X 100
  = 72.5%

PHYSICAL APPERANCE:

PARAMETERS	F1	F2	F3	F4
COLOUR	brown	brown	brown	brown
CONSISTENCY	smooth	smooth	smooth	Smooth
HOMOGENICITY	homogenous	homogenous	homogenous	homogenous
FEEL ON THE SKIN	No irritation	No irritation	No irritation	No irritation

STANDARD GRAPH:

CONCENTRATION	ABSORBANCE 424nm)
0.1	0.148
0.2	0.212
0.3	0.280
0,4	0.382
0.5	0.471
0.6	0.550
0.7	0.636



pH:

F1	F2	F3	F4
4.63	4.11	5.04	4.61
4.51	4.20	5.02	4.57
4.60	4.17	5.01	4.58
AVERAGE=4.58	4.16	5.02	4.58

VISCOSITY:

F1	F2	F3	F4
4500	4300	4800	4600
4500	4300	4800	4700

4500	4400	4700	4600
AVERAGE=4500	4333	4766	4633

SPREDABILITY:

F1	**F2**	**F3**	**F4**
0.58	0.58	0.6	0.4
0.57	0.59	0.62	0.42
0.6	0.6	0.64	0.44
AVERAGE=0.58	0.59	0.62	0.42

CONCLUSION:

On the basis of the study, the data showed that the curcumin gel prepared from the dried methanolic extracts curcumin the significant anti-inflammatory activity when compared with standard Diclofenac gel. As phytochemical tests showed the presence of flavonoids, phenol, anthraquinones, volatileoil, reducingsugar, phlobatannins,amino acids,chalcone in the methanolic extracts they might suppress the formation of prostaglandins and bradykinins or antagonize their action and exert its activity. The curcumin gel showed effect and which can be useful for the treatment of local inflammation.We concluded that from the values of PH, Spreadability, Viscosity, Drug content Turmeric gel made with carbopol 934 (4%) has optimum drug release.

REFERENCES :

1. **Mohsin J. Jamadar*, RajmahammadHusen Shaikh**/ "PREPARATION AND EVALUATIONOF HERBAL GEL FORMULATION"/ *Journal of Pharmaceutical Research &Education*/ISSN:2456 -4508
2. **SUPRIYA AGNIHOTRI1*, SHARAD WAKODE2, ANOOP AGNIHOTRI3**"FORMULATION AND EVALUATION OF HERBAL ANTIACNE GEL OF MYRICA ESCULENTA" /*ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH*vol9,Issue 4, 2016 / Received: 25 April 2016, Revised and Accepted: 04 May 2016.
3. **VaibhavShende*** "FORMULATION AND EVALUATION OF HERBAL TOOTH GEL CONTAINING ALOE VERA: COMPARED STUDY WITH MARKETED PREPARATIONS"/*EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICALRESEARCH*/ejpmr, 2018,5(1), 260-264/Article Revised on 22/11/2017 Article Accepted on 13/12/2017.
4. **DIVYA JYOTHI1***, MARINA KOLAND/ "FORMULATION AND EVALUATION OF AN HERBAL ANT I-INFLAMMATORY GEL CONTAINING TRIGONELLA FOENUM GREACUM SEED EXTRACT"/ .*INTERNATIONAL JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES*/ VOL 8, ISSUE 1, 2016. P. M.
5. **KASAR, K. KALE AND D. G. PHADTARE** : 'FORMULATION AND EVALUATION OF TOPICAL ANTIFUNGAL GEL CONTAINING ITRACONAZOLE" , INTERNATIONAL JOURNAL OF CURRENT PHARMACEUTICAL RESEARCH, 2018, 10(4) 71-74..
6. **SUMEET DWIVEDI* and SHAILESH GUPTA**/ "FORMULATION AND EVALUATION OFHERBAL GEL CONTAINING SESBANIA GRANDIFLORA

(L.) POIR. LEAF EXTRACT"/*ACTA CHIMICA & PHARMACEUTICA INDICA*.

7. **R. Bhramaramba*1 ¸ I. Sudheer Babu2 , Ch. Divya Naga Deepthi**/ "Formulation and Evaluation of Herbal Gel Containing Terminalia chebula Retz., LeavesExtract"/*Scholars Academic Journal of Pharmacy (SAJP).*
8. **Semwal Amit1* , Bhatt Saraswati1 , Upereti Kamalesh1 , Upadhyaya Kumud1**/ "Formulation and Evaluation of a Novel Herbal Gel of Equisetum arvense Extract"/ *Journal of Pharmacognosy and phytochemistry*/ Volume 1 Issue 5.
9. **M. Shaikh*, A. Avalaskar, K. Wadekar, C. Shaha, S. Diwate and S. Shah**/ "FORMULATION AND EVALUATION OF TOPICAL HERBAL GEL FOR LOCAL INFLAMMATION"/ *World Journal of Pharmaceutical Research*/ Volume 7, Issue 19,1284-1289.
10. **Gouri Dixit*, Ganesh Misal, Vijay Gulkari and KanchanUpadhye**/ "FORMULATIONAND EVALUATION OF POLYHERBAL GEL FOR ANTI - INFLAMMATORY ACTIVITY"/*INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCESAND RESEARCH*/ IJPSR (2013), Vol. 4, Issue 3.
11. **Ajinkya M. Bankar, Manjusha N. Dole**/ "Formulation and evaluation of herbalantimicrobial gel containing musaacuminata leaves extract"/*JOURNAL OFPHARMACOGNOSY AND PHYTOCHEMISTRY.*
12. **Nikunjana A. Patel, Natvar J. Patel, and Rakesh P.Patel**/ "Formulation and Evaluation of Curcumin Gel for Topical Application"/*Pharmaceutical Development and Technology.*
13. **Lokesh Prasad MS*, Kalaskar P Gurunath, SB Chandrasekar, Umashankar C, PawarAT**/ "Formulation and evaluation of herbal formulations (Ointment, Cream, Gel) containing Tridaxprocumbens and Areca catechu"/*JOURNAL OF SCIENTIFIC ANDINNOVATIVE RESEARCH.*
14. **SarukhVikram S., NagobaShivappa N.*, Hindole S. S., Kaudewar K. D., More DigamberR**./"FORMULATION AND EVALUATION OF HERBAL GEL CONTAINING Allium cepa EXTRACT"/*Journal of Drug Delivery and Therapeutics*.