Journal of Innovations in Applied Pharmaceutical Science
(JIAPS)

Content available at : www.saap.org.in ISSN:2455-5177

Formulation and evaluation of ficus benghalensis emulgel for its anti- rheumatoid arthritis effect

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Article History

Receiced: 25-08-2021
Revised: 05-09-2021
Accepted: 27-09-2021

Keywords:
Ficus benghalensis, Herbal emulgel, anti-arthritic activity, invitro release method.

Abstract

The current study focuses on the development and characterization of ficus benghalensis powdered aerial roots emulgel to avoid the first-pass effect and strengthen bioavailability while reducing dosage intervals and dose related deleterious reactions. three formulations with same concentration and different polymers were formulated. Ethanolic and petroleum ether extract of dried aerial roots of ficus benghalensis were prepared by using different gelling agents like Carbopol 934, Carbopol 940 and Xanthane gum were formulated. The prepared formulations were evaluated for their qualitative as well as quantitative tests, physical appearance, pH, viscosity, spreadability, consistency, homogeneity, moisture loss and finally in vitro anti-arthritic activity. Depending on the outcomes, it was observed that to all the formulation, F1 formulation containing Carbopol 940 with 4.6% moisture loss, 3780.3±5.0 viscosity and 6.1±0.1 PH and 43.7±1.53 spreadibility shows better activity then all the other. Herbal emulgel of ethanolic extract of dried aerial roots of ficus benghalensis linn when compared with diclofenac emulgel confirms the anti-arthritic activity through invitro release method.

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https://doi.org/10.37022/jiaps.v6i3.230

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Introduction

Rheumatic diseases that cause locomotor vulnerability and impairment in the adult population are known as arthritic dysfunction. Osteoarthritis and Rheumatoid arthritis are the most dominant articular disorders [1]. Rheumatoid arthritis is an autoimmune condition, caused by pro-inflammatory cytokines such as TNF-a, Il-6, IL-1b, and induces joint and organ inflammation [2]. The most common symptom in patients with Rheumatoid Arthritis is joint pain, which is broadly linked to physical impairment, reduced mobility, exhaustion, sleep disruptions and elevated medical expenses, resulting in a depletion in life quality and a significant socio-economic effect [3].

The topical drug delivery system can be used in conditions where other drug delivery systems have failed [4,5]. Skin is the largest organ in the human body, accounting for about 10% of a person's body mass and covering an average of 1.7m2. Emulgels are novel dosage forms and it is the combination of emulsion and gel [6]. It is considered as one of the best formulations for topical usage as the presence of gelling agent in the water phase transforms the classical emulsion into an emulgel [7].

Ficus benghalensis is a laticiferous, moraceaeous, tremendous evergreen tree that belongs to the Moraceae family and ficus genus, which has over 800 species and 2000 sub-varities [8]. Throughout many regions of India, this tree is recognized as sacrilegious [9]. The parts of the tree has been reported to segregate glucoside, 20-tetratriaconthene-2-one, 6-heptatriacontene-10 -one, pentatriacontan-5-one, beta sitosterol-alpha- D-glucose, and meso-inositol [10, 11].

Materials and Methods

Collection of Plant Material

The crude drug (aerial roots) of the plant were collected from the nearby garden, Goel campus Lucknow authenticated by O.P Verma. The aerial roots were washed under tap water and dried in sunlight for 1-2 months and then were finely

powdered in a grinder. The physiochemical parameters of powdered material was done as per the procedure of Saurabh Chaudhary et, all (2016).

Chemicals

Carbopol 940, triethanolamine, petroleum ether, ethanol, propylene glycol, etc. were purchased from Star Micronics Devices and Chemicals.

Preparation of Plant extract

Around 500g of powder was subjected to Soxhlet extraction with petroleum ether (60o-80o C) to defeat the powder and also with ethanol (50o-60o C) for 8 hours, separately.

Then, each extract were filtered and filtrate were evaporated to dryness. The extracts were optimized among other physiochemical specifications in terms of purity, pH, and extractive value.

Phytochemical screening

Qualitative and quantitative chemical tests had been performed on the extracts to identify the constituents by following the procedure of Nathan Harris et,al (2005) and Sampat Navale et, all (2018) [12, 13].

Preparation of gel

To the 200ml water, 1% w/w Carbopol 940 was added and dispersed uniformly, and add 2.1ml of glycerin ensuring no lumps. A 0.5 N NaOH solution was added drop wise, until a gel was formed. The prepared gel was weighed and stored in air-tight containers [14].

Preparation of Ficus benghalensis Emulgel

At first, o/w emulsion having 0.01g aerial roots extracts of ficus benghalensis was formulated by dissolving it in a mixture of 0.5ml of Span 20 in 4.5ml of liquid paraffin, this acts as oil phase, and the aqueous solution was formulated by dissolving 0.5% Tween 20 in a purified water. Both the phases of emulsion were heated separately at 60o-70o C followed by mixing of the two with continuous stirring until the product cooled to room temperature resulting in the formation of ficus benghalensis emulsion. The prepared o/w emulsion was added with continuous stirring to the prepared gel in 1:1 weight ratio to produce homogeneous [15]. (Table.1)

Characterization of Ficus Benghalensis Emulgel

Optimization of emulgel

The prepared gel formulations were visually examined for their texture, color, clarity and existence of particle [16].

Consistency of emulgel [17]

To determine the consistency of the prepared gel, a small amount of gel was squeezed between the thumb and the index finger and the consistency of the gel was observed.

Homogeneity of emulgel [18]

All formulated gels were visually inspected for homogeneity after they were stored in the container. They were examined for their appearance and availability of any aggregates.

Determination of pH [19]

Accurately weighed 1.0g of various prepared gel and dispersed in 100ml purified water. The pH was measured by using digital pH meter. In order to ensure that the formulation can be used without the harm of skin irritancy, the pH of the preparation has been determined.

Spreadability [20]

0.5g gel was mounted within a circle of 1 cm diameter pre-marked on a glass plate of 20*20cm and another glass plate was mounted over it. A mass of 100g was placed on the upper glass slide. The change in diameter due to the expansion of gel was reported.

Viscosity [21]

Viscosity of gel was carried out by using Brookfield Viscometer at 25oC, having spindle speed at 12rpm.

Percentage moisture loss[22]

Precisely weighed films were put in a Desiccator containing fused anhydrous calcium chloride for 24 hours to verify the level of moisture loss from freshly prepared films. After 24 hours, films were again weighed and moisture loss has been calculated by using following formula:

$$\% \text{ Moisture loss} = \frac{\text{Initial wt.} - \text{Final wt.}}{\text{Initial wt.}} * 100$$

In vitro Anti-arthritic activity [23]

The drug release analysis was carried out in a franz diffusion cell apparatus. It is having two compartments, the receptor and the donar compartment. For filling of receptor compartment, phosphate buffer with 7.4 pH was used and temperature maintained at 37+-5oC. Magnetic stirrer was used for continuous agitation. In the donar compartment, 2g of cell was applied and cellulose membrane was placed in between the donar and receptor compartment. The drug release from prepared formulation was analyzed by collecting samples of 0.5ml from the diffusion cell at eight hours intervals. Every time, as 0.5ml of sample was withdrawal, the same amount of sample was filled in the receptor compartment for the maintenance of initial volume. The samples that has been taken out from the receptor compartment has been analyzed in UV. The amount of drug released was calculated by using calibrate curve.

Results

The quantitative physiochemical parameters have been performed to determine the authenticity and purity of plant part. The evaluated result has been listed in table.2.

The qualitative phytochemical screening of aerial roots of ficus benghalensis has been investigated and summarized in table.2.

The prepared emulgel was evaluated by various parameters like optimization, weight, consistency, homogeneity, pH, spread ability, viscosity. The evaluated data has been given in table.3 (i) and (ii).

The aerial roots extract fractions of Ficus benghalensis used are ethanol and petroleum ether.

These extracts showed positive response as compared to std. diclofenac sodium for its anti-arthritic property using in-

vitro release of prepared formulation shows the maximum release of 85% drug in 8 hours. (Table.4)

Table 1: Composition of Various Formulations of Ficus bengalensis Emulgel

Ingredients	Types of formulation		
	F1	F2	F3
F. benghalensis Extract	0.01g	0.01g	0.01g
Polymer (0.8g)	Carbopol 940	Carbopol 934	Xanthane gum 940
Glycerin	2.1 ml	2.1 ml	2.1 ml
Ethanol	0.1ml	0.1ml	0.1ml
Water	q.s.	q.s.	q.s.
Triethanolamine	2%	2%	2%

Table 2: Quantitative Physiochemical Parameters

Parameters	Results
Ash Value	5.0%
Water soluble Ash	2.0%
Acid insoluble Ash	1.0%
Water soluble extractive values	1.74%
% Yield	
Pet-ether	0.46%
Hydro alcoholic	1.68%

Table 2: Qualitative Physiochemical Parameters

S.no	Phytochemicals	Extracts	
		Hydro alcoholic	Petroleum ether
1.	Carbohydrates	++	++
2.	Proteins	--	--
3.	Amino acids	--	--
4.	Steroids	++	++
5.	Glycosides	-+	-+
6.	Saponins	-+	-+
7.	Flavonoids	++	--
8.	Alkaloids	--	--
9.	Tannins	--	++
10.	Phenolic	--	++

Table.3 (i): Evaluation Parameters

Parameters	Types of Formulations		
	F1	F2	F3
Texture	Smooth	Smooth	Smooth
Color	Light	Light	Dark
Clarity	brown	brown	brown
Consistency	Good	Poor	Good
Clarity	Clear	Clear	Clear
Grittiness	Present	Absent	Absent
Homogeneity	Present	Present	Present

Table.3 (ii): Evaluation Parameters

Table.1 Individual Data of pH

Sn.	Formulations	pH
1	Carbopol 940 (F1)	6.1
		6.2
		6.1
2	Carbopol 934 (F2)	5.9
		5.8
		5.8
3	Xanthane gum (F3)	5.2
		5.2
		5.3

Table.2 Group data of pH (Mean±SD)

Sn.	Formulations	pH (Mean±SD)
1	Carbopol 940 (F1)	6.1±0.1
2	Carbopol 934 (F2)	5.8±0.1
3	Xanthane gum (F3)	5.2±0.1

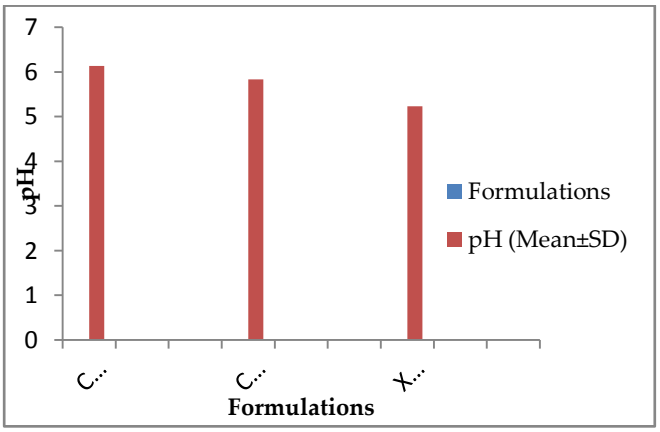

Fig. 1: pH data of different formulation

Table 3: Individual Data of Spread ability

Sn.	Formulations	Spread ability
1	Carbopol 940 (F1)	42
		44
		45
2	Carbopol 934 (F2)	41
		39
		38
3	Xanthane gum (F3)	35
		36
		35

Table 4: Group Data of Spread ability

Sn.	Formulations	Spread ability (Mean ± SD)
1	Carbopol 940 (F1)	43.7±1.53
2	Carbopol 934 (F2)	39.3±1.53
3	Xanthane gum (F3)	35.3±0.6

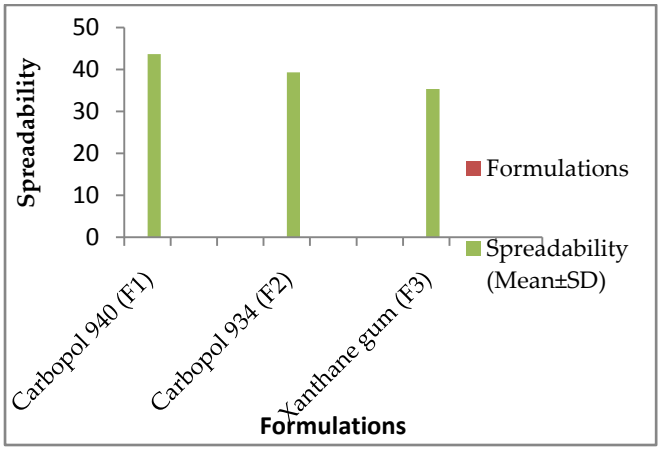

Fig. 2: Spreadabilitydata of different formulation

Table 5: Individual Data of Viscosity

Sn.	Formulations	Viscosity
1	Carbopol 940 (F1)	3785
		3781
		3775
2	Carbopol 934 (F2)	3902
		3908
		3911
3	Xanthane gum (F3)	4001
		4002
		3999

Table 6: Group Data of Viscosity

Sn.	Formulations	Viscosity (Mean±SD)
1	Carbopol 940 (F1)	3780.3±5.0
2	Carbopol 934 (F2)	3907.0±4.6
3	Xanthane gum (F3)	4000.7±1.5

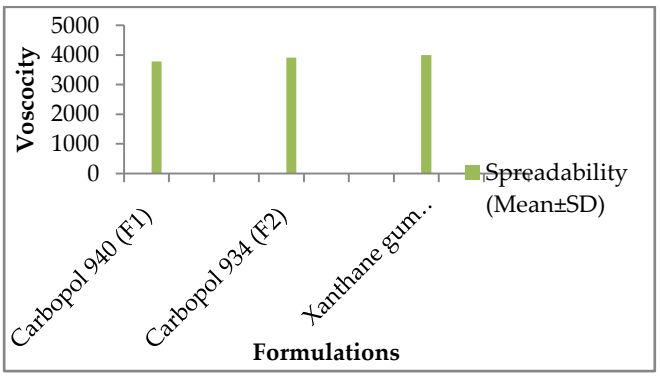

Fig. 2- Viscosity data of different formulation

Table- 1 In vitro Drug Release individual formulations

Sn.	Time	F1			F2			F3		
1	0	0	0	0	0	0	0	0	0	0
2	1	7.02	7.45	7.26	6.25	6.36	6.9	6.01	6.03	6.34
3	2	14.26	14.8	14.36	13.25	13.69	13.09	12.98	13.05	13.98
4	3	22.87	22.69	22.01	21.57	22.03	21.49	22.45	22.56	22.14
5	4	45.09	45.04	45.09	43.28	43.92	43.74	42.84	42.19	41.9
6	5	51.09	51.49	51.74	50.48	50.96	50.17	51.49	52.49	52.34
7	6	70.14	70.69	71.37	69.57	68.99	69.48	68.15	68.02	69.26
8	7	78.09	79.64	78.39	75.69	76.98	79.02	74.02	75.01	74.99
9	8	85.03	85.14	85.69	84.68	83.08	84.56	82.47	82.69	82.49

Table-2: In vitro Drug Release group formulations (Mean±SD)

Sn.	Time	F1	F2	F3
1	0	0±0	0±0	0±0
2	1	7.24±0.53	6.5±0.35	6.13±0.19
3	2	14.47±0.66	13.34±0.31	13.34±0.56
4	3	22.52±0.60	21.69±0.29	22.38±0.22
5	4	45.07±0.90	43.64±0.33	42.31±0.48
6	5	51.44±0.55	50.53±0.40	52.11±0.54
7	6	70.73±0.77	69.35±0.31	68.48±0.68
8	7	78.7±1.65	77.23±1.68	74.67±0.57
9	8	85.29±0.42	84.11±0.89	82.55±0.12

Conclusion

This study was the scientific report that proves convincing phytochemical studies and also observed that, to all the three formulations, the F1 formulation containing Carbopol 940 was best suited with the parameters of the standard diclofenac formulation. The F1 formulation established greater spread ability and consistency when compared with other developed gels. The formulated F1 gel demonstrated good homogeneity, an excellent pH, minimal skin irritation and great stability. The maximum percentage of moisture loss was found to be 4.6% after 24 hrs in F1 formulation. Anti-arthritic efficacy of the aerial roots of ficus benghalensis has been demonstrated giving empirical support to its conventional use by the native people in south India.

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