



Formulation and Evaluation of Emulgel Containing Tridax Procumbens Extract

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Received: 21-01-2023; Revised: 25-03-2023; Accepted: 02-04-2023; Published on: 15-04-2023.

ABSTRACT

Emulgels have emerged as a promising topical drug delivery system for delivering both hydrophobic and hydrophilic drugs. They increase the absorption and enhance the action of the drug. The objective of this study was to formulate and evaluate Emulgel containing extract of *Tridax procumbens* for wound healing activity. The plant has been extensively used in Ayurvedic system of medicine for various diseases like hepatoprotective effect, immunomodulating property, promising wound healing activity, antidiabetic, hypotensive effect, antimicrobial, insect repellent activity, anti-inflammatory and antioxidant, bronchial catarrh, dysentery, diarrhoea also prevent falling of hairs and leads to hair growth promotion. The formulation of Emulgel was done by using Carbapol 940, Span 80, Tween 80, Light Liquid paraffin, Triethanolamine, methyl paraben and extract of TP. The formulated emulgel was evaluated for physical properties like pH, Spreadability, Viscosity and compatibility studies & anti-microbial studies. From the evaluation it was concluded that the formulation F2 Emulgel was better on its physical properties and anti-microbial studies for wound healing activity.

Keywords: Emulgel, *Tridax procumbens*, Wound healing, Anti-microbial activity.

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DOI:
10.47583/ijpsrr.2023.v79i02.028



DOI link: <http://dx.doi.org/10.47583/ijpsrr.2023.v79i02.028>

INTRODUCTION

Tridax procumbens

T*ridax procumbens* Linn. Belongs to Asteraceae family. It is commonly known as 'Ghamra' and in English popularly called 'coat buttons' because of the appearance of flowers. The plant has been extensively used in Ayurvedic system of medicine for various disorders.



Figure 1: *Tridax procumbens* var. *procumbens*

This is dispensed for "Bhringraj" by some of the practitioners of Ayurveda. It is found throughout India, it is native of tropical America and naturalized in tropical Africa, Asia, and Australia. This plant widely distributed and it's each and every part having noble pharmacological activity. The work done till to date on its pharmacological activities like hepatoprotective effect, immunomodulating property, promising wound healing activity, antidiabetic, hypotensive effect, antimicrobial, insect repellent activity, anti-inflammatory and antioxidant, bronchial catarrh, dysentery, diarrhoea also prevent falling of hairs and leads to hair growth promotion.²

Scientific Classification of *Tridax procumbens*:²

Kingdom	:	Plantae
Division	:	Spermatophyta
Subdivision	:	Angiospermae
Class	:	Dicotyledonae
Subclass	:	Cotyloideae
Order	:	Asterales
Family	:	Asteraceae
Common name	:	Coat buttons
Botanical Name	:	<i>Tridax procumbens</i> Linn

Synonyms of *Tridax procumbens*:²

- ❖ Coat buttons
- ❖ Mexican daisy
- ❖ Tridax daisy

Traditional uses of *Tridax Procumbens*: ²

Tridax procumbens possesses significant anti-inflammatory, hepatoprotective, wound healing, antidiabetic activity and antimicrobial activity against both gram-positive and gram-negative bacteria. The leaf juice possesses antiseptic, insecticidal and parasiticidal properties and it is also used to check hemorrhage from cuts, bruises and wounds. The leaves are used for bronchial catarrh, dysentery, diarrhea, prevent falling of hair and also promotes the growth of hair, insect repellent. Interestingly it also has hypotensive effect and potent immunomodulating property. In the West Africa sub-region and tropical zone of the world, Traditional medical practitioners and the native peoples of these areas use the leaves of the plant as a remedy against conjunctivitis. It is also used as bio adsorbent for chromium (VI) which is one of the highly toxic ions released into the environment through leather processing and chrome plating industries.

Emulgel⁴

Emulgel is a semi-solid preparation in which emulsion is incorporated in gel base. Emulgel is a promising drug delivery system for the delivery of hydrophobic drugs. They can be made of either oil-in-water or water-in-oil type. Emulgel is a stable and superior system that incorporates poor water-soluble drugs. Emulgel can deliver both hydrophilic and lipophilic drugs due to the presence of both aqueous and non-aqueous phases. In recent years, they have been used as a control release formulation. These are biphasic systems that have better drug loading capacity and better stability. Emulgel has both gel and emulsion properties and functions as dual drug control release system.

Advantages of emulgel over conventional topical formulation:

- High absorption of drug in skin
- Good spreadability
- Greaseless
- Thixotropic in nature
- Good shelf life
- Odorless and has pleasant appearance

Types of Emulgel❖ **Microemulsion**

Microemulsions are isotropic mixtures of a biphasic o/w systemic stabilized with a surfactant that is thermodynamically stable and optically clear. Droplets vary in size from 10 to 100nm and do not coalesce. It is made up of specific amounts of oil, co-surfactant, surfactant, and water. Microemulsions may have unique properties, including extremely low interfacial tension, a broad interfacial region, and the ability to dissolve both aqueous and oil-soluble compounds. The ingredients in microemulsion could help the drug permeate faster by

lowering the stratum corneum's diffusion barrier.

However, because of their low viscosity, the use of microemulsions in the pharmaceutical industry is limited due to their low skin retention ability. To address this limitation, gelling agents like HPMC K100M, Carbopol 940, and guar gum are added to the microemulsion to form microemulsion-based gels with a viscosity appropriate for topical application.

❖ **Nanoemulgel**

Nanoemulsion is transparent (translucent) oil-water dispersions that are thermodynamically stable due to surfactant and co-surfactant molecules with a globule size range from 1nm to100 nm. When the emulsion is mixed with gel, the term nanoemulgel is used. Many drugs have higher transdermal permeation with nanoemulgel than with traditional formulations such as emulsions and gels. The nanoemulsion possesses enhanced transdermal and dermal delivery properties in vivo as well as in vitro. Because of its high loading capacity and small globule size, the drug easily penetrates the skin and provides good therapeutic effect in a short period.

❖ **Macroemulsion gel**

Emulgel with emulsion droplet particle sizes greater than 400nm. They are physically invisible, but under a microscope, the individual droplets can be seen clearly. Macroemulsions are thermodynamically unstable, but surface-active agents can help to stabilize them.

Preparation of Emulgel⁵

Emulgel is the mixture of emulsion and gel together. Therefore, emulsion and gel are prepared separately.

Preparation of emulsion:

Emulsion is prepared by mixing aqueous phase and oil phase together. The oil phase is prepared by mixing Span 80 in liquid soft paraffin whereas aqueous phase is prepared by mixing Tween 80 in purified water. Methyl paraben and propyl paraben as preservatives are mixed along with oil phase. Both the phases are heated at 70°C and 80°C. The oil phase was slowly added to aqueous phase with constant stirring until stable emulsion was formed.

Preparation of gel:

Gel is prepared by mixing Carbapol 940 in water at constant speed using stirrer. Triethanolamine is added dropwise until the pH is adjusted between 6-6.9.

Preparation of emulgel:

Emulgel is prepared by mixing emulsion and gel at 1:1 ratio by gently stirring.

Formulation of *Tridax procumbens* Emulgel**Formulation of gel:**

Accurately weighed Carbapol 940 was taken and dispersed in beaker containing 300ml of distilled water. The beaker was set aside for half an hour for allowing Carbapol 940 to

swell. Methyl paraben sodium was dissolved in water. The Carbapol 940 was stirred continuously until no lumps are found. Then add 5-6 drops of Triethanolamine and methyl paraben sodium to the Carbapol 940 and stir continuously until a clear, transparent gel is formed.



Figure 5: Gel base

Formulation of emulsion:

The oil phase of the emulsion was prepared by dissolving Span 80 in Light liquid paraffin and the extract of *Tridax procumbens* was added and heated to 70°C. Methyl paraben was dispersed in oil phase. The aqueous phase was prepared by dissolving Tween 80 in purified water and heated to 80°C. The oil phase was slowly added to aqueous phase with constant stirring until stable emulsion was formed.



Figure 6: Emulsion containing TP Extract

Formulation of emulgel:



Figure 7: Emulgel containing TP Extract

The gel and the emulsion containing the extract of *Tridax procumbens* was mixed in 1:1 ratio and gently stirred to form the emulgel.

Table 1: Excipient profile

Ingredients	Uses
<i>Tridax procumbens</i> extract	Wound healing, anti-microbial, anti-inflammatory
Carbapol 940	Gelling base
Span 80	Emulsifying agent
Light Liquid Paraffin	Vehicle to dissolve oil phase
Tween 80	Emulsifier
Triethanolamine	pH neutralizer
Methyl paraben	Preservative

Table 2: Formulation of Emulgel

S.NO	Ingredients	Formulations	
		F1	F2
1	<i>Tridax procumbens</i> extract (mg)	1mg	2mg
2	Carbapol 940 (g)	1.2g	1.2g
3	Span 80 (ml)	3ml	3ml
4	Light liquid paraffin (ml)	25ml	25ml
5	Tween 80 (ml)	3ml	3ml
6	Triethanolamine	5-6 drops	5-6 drops
7	Methyl paraben (g)	0.10g	0.10g
8	Distilled water	q.s	q.s

Evaluation

The Formulated Emulgel was subjected to the following Evaluation parameters.

➤ **Measurement of pH:**⁶

The pH of emulgel formulations was determined by using digital pH meter. One gram of emulgel was dissolved in 100 ml of distilled water and it was kept aside for 2 hr. The pH of each formulation was measured.

➤ **Spreadability:**⁷

The emulgel was sandwiched between 2 petri plates and the diameter of circle of spreaded emulgel was used to determine the spreadability. 1 gram of emulgel was weighed and placed on a petri plate. Other petri plate was placed on its top and weight of 50 grams was placed on the top of petri plate for about 60 seconds. After completion of 60 seconds the diameter of circles formed from the spreaded emulgel were measured in triplicate. The average of the reading was calculated. The reading was put into the following formula.

$$S = M \times L \times T$$

Where,

S: Spreadability

M: Mass

L: Diameter

T: Time

➤ **Viscosity:**⁸

Viscosity measures the flow characteristics of emulgel formulation. Change in viscosity of the product is indicative of change in stability and effectiveness of product. The viscosity of emulgel was determined by using Brookfield DV-II+Pro.

➤ **Homogeneity:**⁹

All formulated emulgel were tested for homogeneity by visual inspection. They were tested for their appearance and presence of any aggregates.

➤ **Grittiness:**⁹

All the formulations were evaluated microscopically for the presence of particles. Hence the emulgel preparation is free from any particulate matter and from grittiness as desired for any topical preparation.

➤ **Compatibility Studies:**

The incompatibility between the leaf extract and the excipients were studied by FTIR spectroscopy. The results indicate that there was no chemical incompatibility between the extract and the excipients used in the formulation of emulgel.

➤ **Determination of Antimicrobial Activity:**

The antimicrobial activity of the emulgel was done using kirby bauer agar well diffusion assay. Bacterial cultures such as *Bacillus subtilis*, *E. coli*, and fungal culture *Candida albicans* were used for determining antimicrobial activity.

RESULTS AND DISCUSSION

Physical properties of Emulgel:

Table 3: Physical evaluation

Physical Evaluation of F1 & F2	Results
Appearance (Nature) of the Emulgel	Semi-solid
Colour	Light greenish colour
Odour	Pleasant odour

The formulated Emulgel was evaluated for its organoleptic properties like colour, odour and state. The formulations

F1 & F2 was found to be semi-solid in nature, pleasant odour and light green in colour.

Determination of pH:

The pH of the formulated Emulgel (F1 and F2) was found to be between 6 to 7 which is in the range of skin pH. The pH of F1 was found to be 6.6 and pH of F2 was found to be 6.3. Hence, the formulated Emulgel is within the Skin pH range.

Table 4: pH of the F1 and F2 Emulgel

S.NO	Formulation Code	pH
1.	F1	6.6
2.	F2	6.3

Determination of Spreadability:

The spreadability plays an important role in patient compliance and ensures uniform application of emulgel to the skin surface. The values of spreading coefficient of the formulated Emulgel suggest that it is easily spreading on the surface of skin. The spreadability test shows the formulated F1 & F2 Emulgel has good spreadable property.

Table 5: Spreadability of F1 and F2 Emulgel

S.NO.	Formulation code	Spreadability
1.	F1	5.4
2.	F2	5.7

Determination of Viscosity:

Viscosity is an important factor that is used for studying the rheological property of the formulation. Viscosity is determined using Brookfield viscometer DV-II+Pro at room temperature. The formulated Emulgel F1 and F2 were found to be 3190±1.28 and 3593±10.26.

Table 6: Viscosity of F1 and F2 Emulgel

S.NO.	Formulation code	Viscosity
1.	F1	3190±1.28
2.	F2	3593±10.26

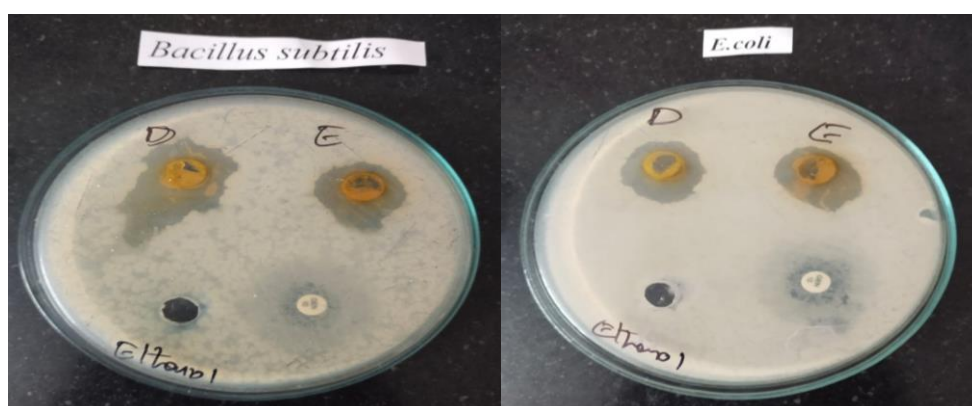


Figure 8: Antibacterial activity of TP Emulgel, TPE, Control, Ethanol

Table 7: Antimicrobial activity of F1 and F2 Emulgel

Sample	Sample Concentration 100 µl added and Zone of inhibition (mm/ml)				
	D/F2 (2mg)	E/F1(1mg)	Extract	Control (Amoxicillin)	Ethanol
<i>Bacillus Subtilis</i>	25	20	11	20	0
<i>E. coli</i>	28	20	12	20	0
<i>Candida albicans</i>	32	24	13	22	0

Determination of antimicrobial activity:

The prepared TP Emulgel of F1 & F2 formulation was exhibited for antimicrobial activity against various microorganisms causing wound infecting such as *Bacillus Subtilis*, *E. coli* and *Candida albicans*.

Table 8: Summary of evaluation of F1 and F2 Emulgel

Formulation code	F1	F2
Homogeneity	++	+++
Grittiness	-	-
Spreadability	5.4	5.7
Physical appearance	Clear	Clear
Viscosity	3190±1.28	3593±10.26
pH	6.6	6.3

++ - Good, +++ - Excellent

(-) = Absence of particulate matter

CONCLUSION

From the study we concluded that the two different formulation of TP extract were formulated as Emulgel. The formulated Emulgel was evaluated for various parameters like physical properties, viscosity, pH, spreadability, compactability and antimicrobial activity. The results of physical parameters showed that the prepared emulgel (F2) shows good stability. The antimicrobial property of the TP Emulgel(F2) was too good when compared to the ethanolic TP extract alone. The study will further carry to *in vivo* study in future.

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Source of Support: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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