IJBPAS, June, 2025, 14(6): 3246-3257

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

DEVELOPMENT AND CHARECTARIZATION OF IXORA COCCINEA LINIMENT TO ALLEVIATE NOCICEPTIVE ACTIVITY

NANDRU M*, YAMUNA K, CHARUNYA A, KRISHNA TULASI D, MANASWINI J, SABRIN SK AND RAMA RAO N

Chalapathi Institute of Pharmaceutical Sciences, Lam, Guntur (A.P), India

***Corresponding Author: Dr. Mounika Nandru: E Mail: mounikanandru@gmail.com**

Received 15th Feb. 2024; Revised 19th March 2024; Accepted 24th July 2024; Available online 1st June 2025

https://doi.org/10.31032/IJBPAS/2025/14.6.9078

ABSTRACT

This research work is undertaken with the aim to formulate and evaluate *Ixora coccinea* liniment. Three different formulations were prepared and observed the physical characteristics like color, odor, and pH. The pH of the prepared formulations was found in between **5.24** to **5.54** which lies in normal pH range of the skin. The spectra of API and prepared formulations were determined by ATR-FTIR model. The particle size was also determined by microscopic method and the average particle size in the formulated liniment was **3.5 *µm*** it concludes that final product is safe and compatible with excipients and also without causing any adverse effects. *In-vitro* drug release studies was performed and evaluated using Franz diffusion cell. From all the formulations F3 was concluded as optimized formulation as it showed higher drug release.

Keywords: *Ixora Coccinea,* Liniment, pH, ATR-FTIR, Microscopic method, Franz diffusion cell

INTRODUCTION:

The liniments are liquid or semi-liquid preparations meant for application to skin. The liniments are usually applied to the skin with friction and rubbing of the skin. The liniments could be emulsions or solutions that are alcoholic or oily. Alcohol enhances the anti-irritant and rubefacient properties of medications and facilitates their entry into the skin when used in liniments. Arachis oil, turpentine oil, and eucalyptus oil are utilized in oily liniments because they spread more readily on the skin. Some liniments also

contain soap as a component, which facilitates the simple application of liniment to the skin. Liniments typically contain medications with anti-inflammatory, analgesic, rubefacient, soothing and stimulating qualities. The wounded skin should not have a liniment applied to it because it may cause excessive irritation. Liniments have a broad range of medicinal uses, based on the components they contain. The usage of liniment is employed for discomfort in the shoulder and neck, low back, muscles, or pain resulting from sprains, contusions, muscle edema, and arthritis.

Medicinal plants are thought to be therapeutically helpful because they contain a variety of phytochemical elements that treat a variety of ailments. Traditional herbal medicine is becoming more and more popular these days for this reason. Because it is less expensive and has less side effects than available synthetic medications, herbal medicine is quickly becoming a popular treatment option for a variety of disorders. From therapeutic plants, a variety of chemical substances have been isolated. Currently, over 70% of people in poor nations rely on traditional medicine, also referred to as complementary or alternative medicine. Ixora coccinea is one of the oldest known remedies derived from plants. The purpose of this study was to construct and assess Ixora coccinea liniment's anti-nociceptive properties.

The most significant vital indicator is pain. The International Association for the Study of Pain (IASP) in 2020 described it as a painful emotional and sensory experience linked to or similarly connected to tissue injury or potential harm to tissue. Considering the rise in expectations of patients for better standards of living, requirements for equally growing is pain management **[1-4]**.

MATERIALS AND METHODS:

Materials: *Ixora coccinea* leaves collected from the medicinal garden, CLPT, Turpentine oil is purchased from Tarapur MIDC, Boisar, Plaghha. Glycerin is purchased from B- wing, Delhi, Camphor was purchased from Manimala road, Edappally, Kochi, Kerala, INDIA.

Method of preparation of Ixora coccinea leaf powder:

Initially, the leaves are collected from the *Ixora coccinea* plant. Then, these leaves are washed thoroughly under faucet water. The leaves were subjected to shade drying for 4 weeks. After the leaves were dried, they were crushed into the form of powder. Further, the crushed powder is stored in a container for formulation.

Table: 1 Composition of *Ixora Coccinea* Liniment

S. No.	INGREDIENTS	F1	F2	F3
1.	*Ixora Coccinea* leaf powder	0.1gm	0.1gm	0.1gm
2.	White Soap base	5gm	8gm	7gm
3.	Turpentine oil	6.4ml	6.6ml	6.6ml
4.	Camphor	0.8gm	0.8gm	0.8gm
5.	Glycerine	Q.S	Q.S	Q.S

FORMULATION-1:

In this formulation, *Ixora coccinea* leaf powder possesses anti-nociceptive activity, turpentine oil was used as a counter irritant and rubefacient, camphor acts as counter irritant, antiseptic, and mild insecticidal activity, glycerin was used for a soothing effect and ease of application, white soap base acts as emulsifying agent which was required for the stabilization of the formulation.

Take a clean and dried mortar and pestle. Then, an accurately weighed quantity of 0.1gm of *Ixora coccinea* leaf powder was placed in a mortar. 6.5 g of white soap base was weighed, placed in a China dish, and subjected to heating. Then 0.8g of camphor was weighed and dissolved in 6.4ml of turpentine oil. After the soap was melted simultaneously, add the camphor and turpentine mixture and the melted soap base to mortar and pestle containing Ixora coccinea leaf powder, triturate it until thick creamy formulation. Finally make up with glycerin and stored in a container.

FORMULATION-2:

The *Ixora coccinea* powder was sieved (sieve no. 100). Take a clean and dried motor and pestle. Then, an accurately weighed quantity of 0.1g of Ixora coccinea leaf powder was placed in a mortar. 8 g of white soap base was weighed, placed in a China dish, and subjected to heating. Then 0.8g of camphor was weighed and dissolved in 6.6 ml of turpentine oil. After the white soap base is melted simultaneously, add the camphor and turpentine mixture and the melted soap base to a mortar and pestle containing ixora coccinea leaf powder and triturate it. Finally, make up glycerine and store it in a container.

FORMULATION-3:

The *Ixora coccinea* powder was sieved (sieve no. 150). Take a clean and dried motor and pestle. Then, an accurately weighed quantity of 0.1g of Ixora coccinea leaf powder was placed in a mortar. 7 g of white soap base was weighed, placed in a China dish, and subjected to heating. Then 0.8g of camphor was weighed and dissolved in 6.6 ml of turpentine oil. After the soap is melted simultaneously, add the camphor and turpentine mixture and the melted soap base to a mortar and pestle containing ixora coccinea leaf powder and triturate it. Finally, make up glycerine and store it in a container.

Figure 1: Formulation Trials of *Ixora Coccinea* Liniment

Identification tests for *Ixora Coccinea*:

It gives positive test for bontragers test, Wagner's test, $FeCl_3$ test, Sudan –III test and salkowski's test which indicates presence of glycosides, alkaloids, tannins volatile oils and steroids. It gives negative test for molisch test, ninhydrin test, xanthoproteic test and test for fixed oils which indicates absence of carbohydrates, amino acids and proteins.

EVALUATION PARAMETERS:

COMPATIBILITY STUDIES:

Fourier- Transform Infrared Spectroscopy (FTIR):

Fourier Transform Infrared Spectroscopy is the most widely used technique for easy identification of materials. No prior sample preparation is required in order to perform this analysis. A Bruker Alpha-II FTIR spectrometer is used. It is a quick, easy and reliable for IR analysis. The sample was placed directly on the diamond crystal plate. The cleaning of the diamond crystal plate is an essential step before placing the sample on it. After the measurement of sample, the data is automatically obtained and the graphs with peaks are interpreted with the obtained data.

Partition Coefficient:

It is also regarded as Distribution Coefficient. It is the ratio of concentration of a substance in one phase (C_1) to the concentration of substance in the second phase (C_2), when the two concentrations are at equilibrium. It is an indicator of drug lipophilicity. The drug is added to a mixture of immiscible liquids, and the drug is allowed to distribute between two phases, in which each phase becomes saturated.

It is calculated by following equation:

$$K_{O/W} = C_{Organic}/C_{Aqueous}$$

The immiscible liquids generally used are water and organic solvents like n-octanol, benzene and chloroform etc. The drugs having

partition coefficient value >2 can easily cross the Blood Brain barrier.

The partition coefficient is calculated by using the following formula:

$$N_1V_1=N_2V_2$$

pH Determination:

It is defined as the negative logarithm of H+ ion concentration, in which the saliva is highly acidic in nature. The pH of the substance is determined to identify whether the substance is acidic or basic in its nature. pH is a critical factor for topical preparations. Skin pH is considered as an important factor. The pH of topical products range between 4-6. The pH can be determined by using pH meter by using acetate phosphate buffer solution **[7]**.

Franz cell diffusion:

Franz diffusion cells are mainly used in the determination of the *ex-vivo* skin permeation. However, when biological skin is not available synthetic membranes are employed. The synthetic membranes employed in Franz cell drug diffusion studies have two functions like simulation of the skin and quality control. The diffusion cells consist of a donor chamber and a receptor chamber which are separated by a membrane – e.g., skin. Sample introduction is done at the top of the donor compartment. Test sample is placed in contact with a membrane and the rate of transfer is determined by collection of permeate on the other side of the membrane. An appropriate receiving solution e.g., phosphate buffer is filled into the Franz receptor cells. Membranes are mounted in horizontal glass Franz-type diffusion cells. It is mainly used in in vitro drug release from liniment. The main mechanism involved here is passive diffusion.

Determination of Globule size:

The particle size of globules in a semi solid dosage form like liniment can be determined visually through a microscope. This helps in the determination of size of globules and the consistency of the product. The globule diameter ranges between 0.1 and 10μm. It is the most direct measure of particle size above 1μm. Sample preparation usually follows sandwiching about 100μl of sample between a slide and coverslip with gentle pressure to achieve a sample thickness of about 25μm. Later, by focusing the particle sizes of respected particles were determined and calculated. Visualization through Microscope of topical pharmaceutical dosage forms is usually limited to bright-field microscopy and polarized light microscopy (PLM) **[5]**.

RESULTS AND DISCUSSION:

Compatibility studies (FTIR)

Table 2: Results of FTIR

Functional Group	Drug	Formulation 1	Formulation 2	Formulation 3
O-H (Acids)	3101.18	3293.34	3300.96	3299.68
C-H	2849.53	2927.38	2925.56	2924.94
C=O	1717.87	1644.42	1743.62	1743.27
C-O	1014.60	1037.15	1038.84	1105.53
C-C	1102.25	1213.54	1216.16	1274.30
C=C	1539.01	1556.47	1556.50	1556.25

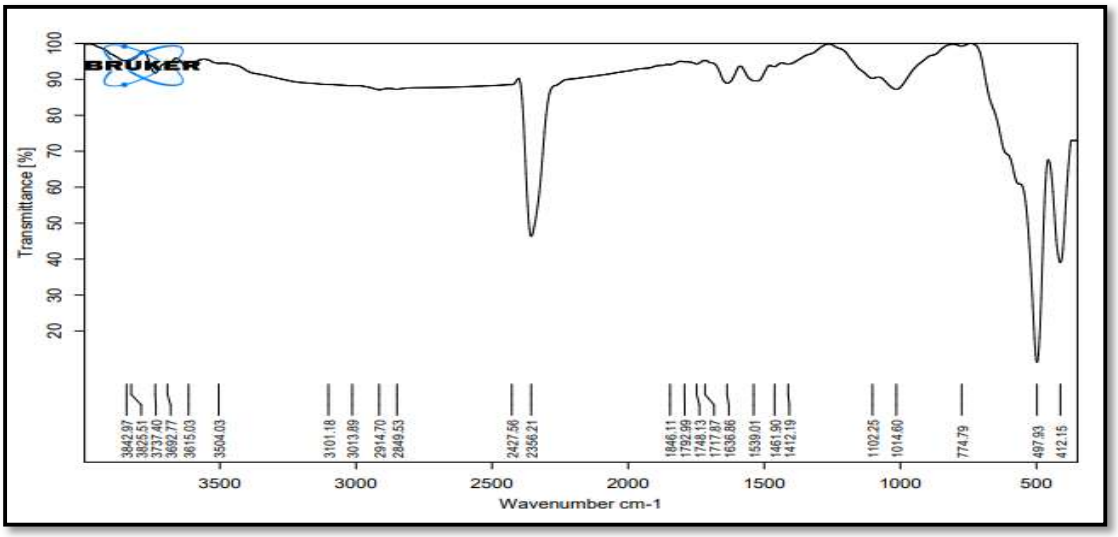

Figure 2: Spectra of Ixora Coccinea Leaf powder (API)

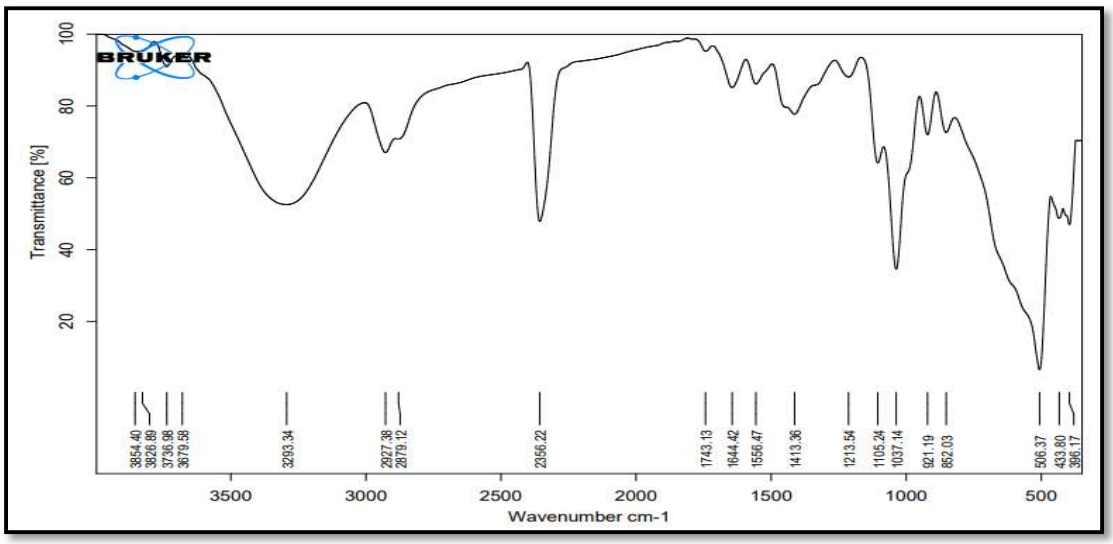

Figure 3: Spectra of *Ixora Coccinea* Liniment-Formulation 1

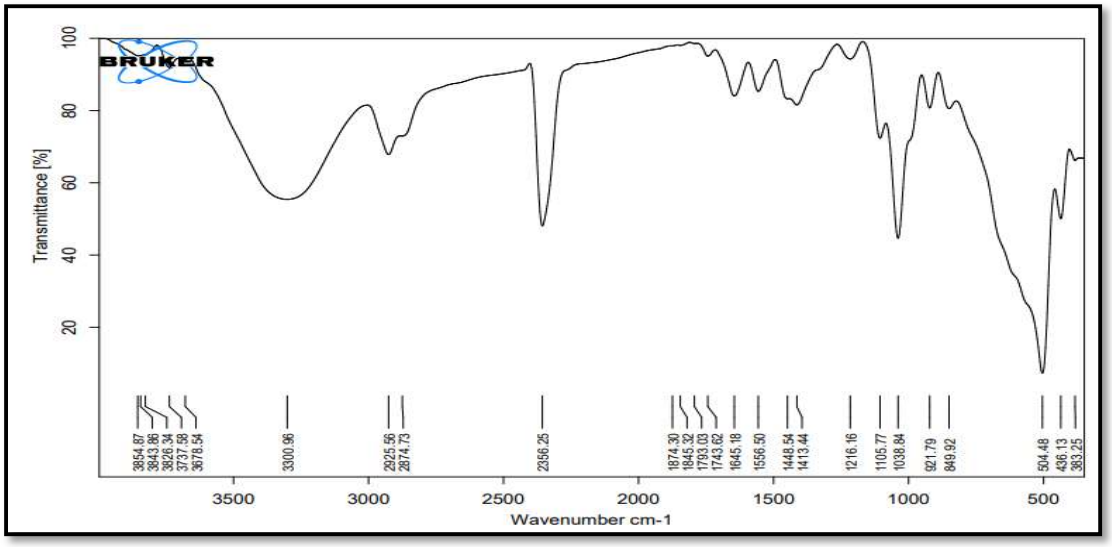

Figure 4: Spectra of *Ixora Coccinea* Liniment-Formulation 2

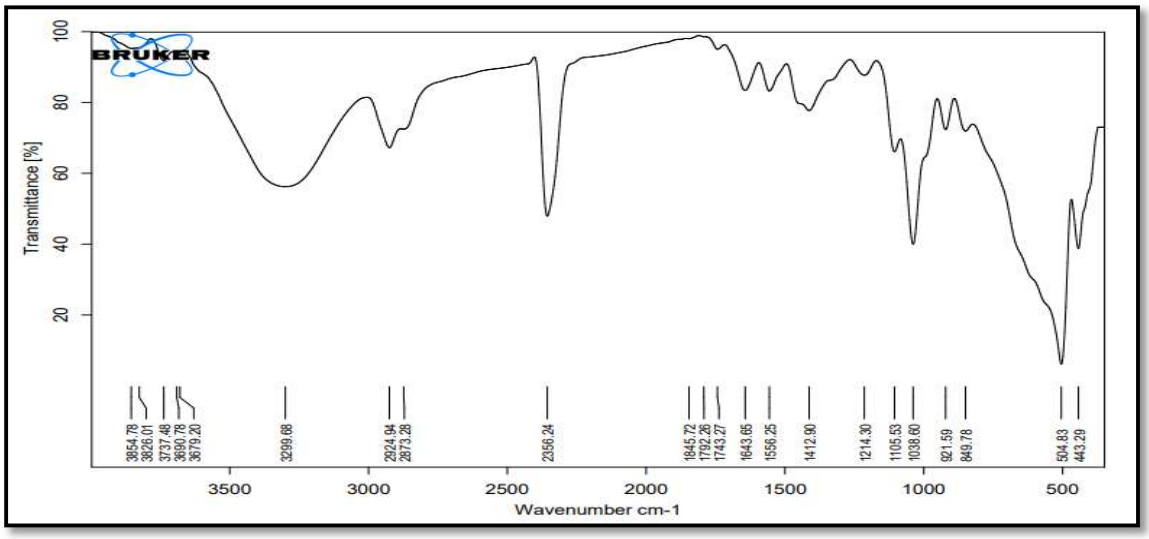

Figure 5: Spectra of *Ixora Coccinea* Liniment-Formulation 3

pH Determination:

Table 3: Results of pH

Trials	Formulation 1	Formulation 2	Formulation 3
Trial 1	5.43	5.25	5.58
Trial 2	5.38	5.23	5.50
Average	5.40	5.24	5.54

Partition coefficient:

Trial 1:

a) Aqueous phase: $N_1V_1 = N_2V_2$

N_1 = Normality of sodium hydroxide = 0.1N

V_1 = Volume of sodium hydroxide consumed
N_2 = Normality of unknown concentration =?
V_2 = Volume of unknown concentration = 10ml

$V_1 = 0.2ml$

$$N_2 = \frac{0.1 \times 0.2}{10} = 0.002N$$

b) Organic phase:

$V_1 = 0.6ml$

$$N_2 = \frac{0.1 \times 0.6}{10} = 0.006N$$

$$\mathbf{K_{O/W}} = \frac{\text{Organic phase}}{\text{Aqueous phase}} = 0.006/0.002 = 3$$

Trial 2:

a) Aqueous phase:

$V_1 = 0.2ml$

$$N_2 = \frac{0.1 \times 0.2}{10} = 0.002N$$

b) Organic phase:

$V_1 = 0.4ml$

$$N_2 = \frac{0.1 \times 0.4}{10} = 0.004N$$

$$K_{O/W} = \frac{\text{Organic phase}}{\text{Aqueous phase}} = 0.004/0.002 = 2$$

$$\textbf{Average:} \frac{\text{Trial 1 + Trial 2}}{2} = (3+2)/2 = \mathbf{2.50}$$

Identification tests for *Ixora Coccinea*:

Table 4: Results for identification tests

S.No.	Test Name	Inference
1.	Molisch test	Absence of carbohydrates
2.	Ninhydrin test	Absence of amino acids
3.	Xanthoproteic test	Absence of proteins
4.	Bontragers test	Presence of glycosides
5.	Wagner's test	Presence of alkaloids
6.	Ferric chloride test	Presence of tannins
7.	Salkowski test	Presence of triterpenoids
8.	Shinoda test	Presence of flavonoids
9.	Test for volatile oils	Presence of volatile oils
10.	Test for fixed oils	Absence of fixed oils

Determination of average globule size in the formulated liniment:

Table 5: Results of average globule size

S. No.	Size range in *µm*	Mean size range *µm* (d)	No. of particles in each size range (n)	%Frequency no. of particles	Cumulative %frequency	n×d
1.	1-2	1.5	32	32	32	48
2.	2-3	2.5	29	29	32+29=61	72.5
3.	3-4	3.5	22	22	61+22=83	77
4.	4-5	4.5	13	13	83+13=96	58.5
5.	5-6	5.5	4	4	96+4=100	22

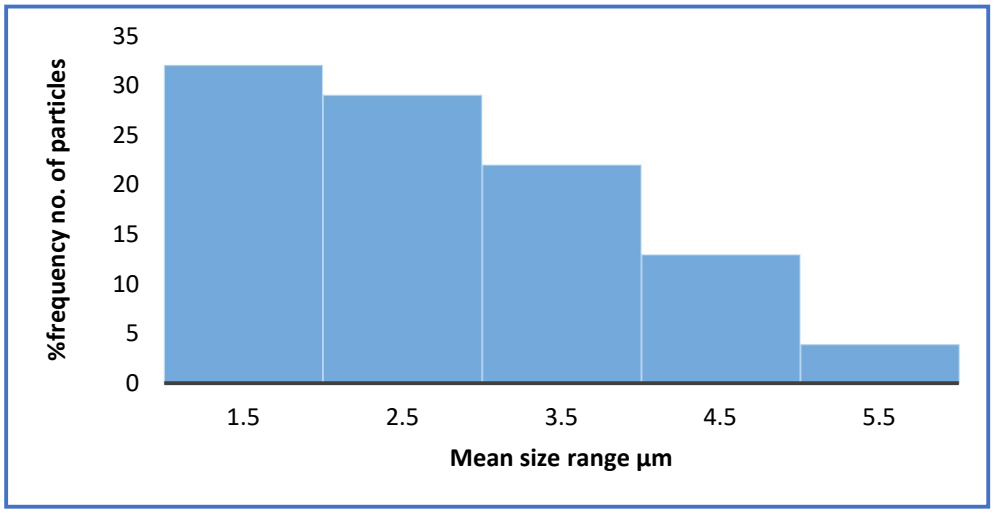

Figure 6: Histogram

Table 6: Results of average globule size

S.No.	n×d²	n×d³	% n×d³	%Cumulative frequency weight under size	%Cumulative frequency weight over size
1.	72	108	3.20	3.20	96.8
2.	181.25	453.125	13.50	16.7	83.3
3.	269.5	943.25	28.11	44.81	55.19
4.	263.25	1184.62	35.36	80.12	19.83
5.	121	665.5	19.83	100	0

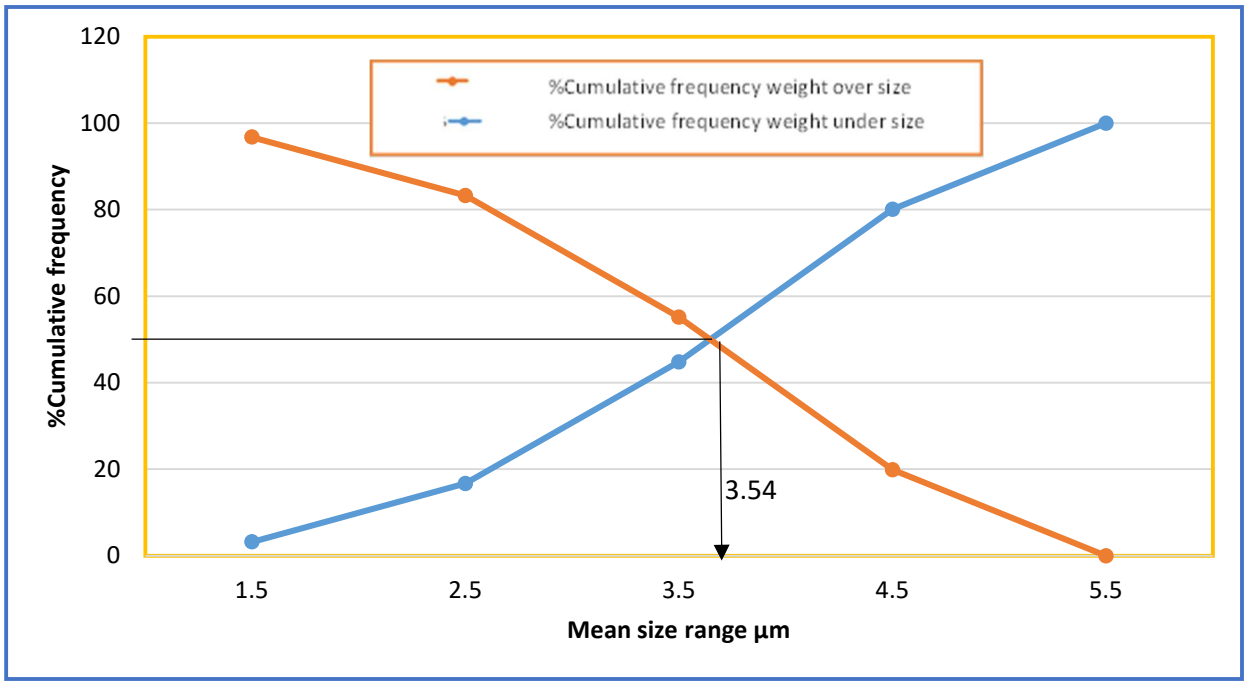

Figure 7: Cumulative Curve

The average particle size distribution is observed from %cumulative frequency in the size range of **3.54 *µm***

Franz cell diffusion studies:

Table 7: Standard Calibration Curve

S.No.	Concentration (µg/ml)	Absorbance
1.	2	0.26
2.	4	0.42
3.	6	0.62
4.	8	0.87
5.	10	0.98

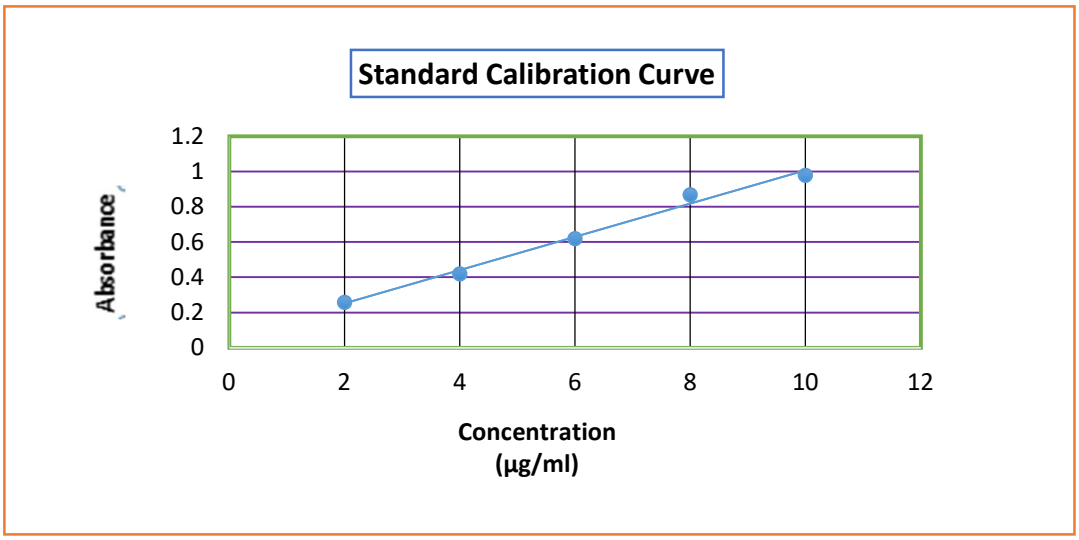

Figure 8: Standard Calibration Curve

Table 8: Results for Drug release from the formulation

Time(min)	% Drug release from the formulation		
	F1	F2	F3
30	5.28%	9.12%	16.32%
60	7.92%	12.24%	18%
90	9.36%	16.56%	22.56%
120	11.76%	19.68%	38.64%
150	13.44%	22.32%	45.88%
180	15.12%	29.04%	48.24%
210	18.24%	34.08%	54.24%
240	21.36%	39.60%	62.88%

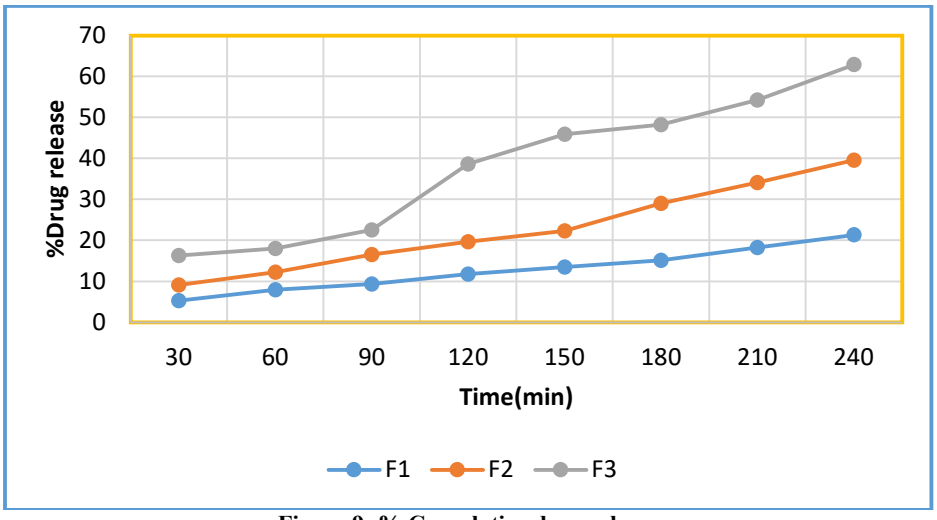

Figure 9: % Cumulative drug release

CONCLUSION:

The goal of this research work is to formulate and evaluate *Ixora coccinea* liniment. In order to determine and compare the penetration activity, we conducted 3 formulation studies. Based on the outcomes of *in-vitro* testing from all the formulations F3 was determined to be most effective formulation. According to in-vitro studies, F3 penetrates the skin and demonstrated that efficient penetration achieves through F3 formulation.

ACKNOWLEDGEMENT:

The authors are thankful to Department of Pharmaceutics and Principal, Prof. Rama Rao Nadendla, Chalapathi Institute of Pharmaceutical Sciences, Lam, Guntur, and Andhra Pradesh for providing all the facilities to complete the research work.

REFERENCES:

[1] Sneha G. Nair, Vikram R. Jadhav and Satyam S. Bakare, Ixora coccinea: Study of Phytochemical Parameters and Antioxidant Activity, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 7 Issue 8, August 2018.

[2] Ariyanti *et al*., Analysis of the advantage of respondents formulation of liniment aromaterapy of essential oil *syzygium aromaticum* L., Proceedings of the International Conference on Nursing and Health Sciences, Volume 1 No 1, November 2020, Page 229 – 234 Global Health Science Group.

[3] Guo J, Hu X, Wang J, Yu B, Li J, Chen J, Nie X, Zheng Z, Wang S, Qin Q. Safety and efficacy of compound methyl salicylate liniment for topical pain: A multicenter real-world study in China. Front Pharmacol. 2022 Oct 21; 13:1015941. doi: 10.3389/fphar.2022.1015941. PMID: 36339533; PMCID: PMC9634125.

[4] Suraj T. Jadhav, Nitin A Gaikwad, Indrajeet V Mane, Manohar D Kengar, Abhishek S. Pujari, Shubham B. Devkar. Formulation and Evaluation of Ointment and Liniment using *Moringa oleifera* Seed Extract. Res. J. Pharmacognosy and Phytochem. 2019; 11(2):45-48. doi: 10.5958/0975-4385.2019.00009.8.

[5] Sandeep Doppalapudi *et al*., Formulation aand evaluation of Anti-inflammatory activity of Lemon grads oil Liniments on wistar rats, Asian Journal of Pharmacy and Pharmacology 2018; 4(4): 434-439.

[6] Rajeev Garg, Sharanpreet Kaur, Ritika, Shehnaz Khatoon, Naina, Hitesh Verma, A Complete and Updated review on various types of drug delivery systems, International Journal of Applied Pharmaceutics, Vol 12, Issue 4, 2020, 1-16.

[7] Milica Lukic, Ivana Pantelic and Snezana D Savac; towards the optimal pH of the skin and Topical formulations; Cosmetics 2021,8,69. Pg no. 3 and 7.