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Formulation and Evaluation of Microemulsion Containing Blue Tansy Oil

Jai Prakash Baswal[*1], Dr Azharuddin[2], Sheeba Khan[3]

[1]Research Scholars, Sunrise Pharmacy College, SunRise University, Alwar

[2]Associate Professor, Sunrise Pharmacy College, SunRise University, Alwar

[3]Lords International College of Pharmacy, Lords University, Alwar

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Address for Correspondence: Jai Prakash Baswal

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Abstract

Blue Tansy oil, derived from the Tanacetum annuum plant, is known for its soothing and anti-inflammatory properties. When formulated into a microemulsion, it typically means the oil is dispersed in water with the help of surfactants (surface-active agents) to create a stable mixture. This microemulsion form enhances the oil's absorption into the skin, making it easier to apply and potentially increasing its effectiveness. Microemulsions are preferred in skincare for their ability to deliver active ingredients more effectively, penetrate the skin barrier, and provide a more pleasant texture compared to traditional oil-in-water or water-in-oil emulsions.

Keywords: Blue Tansy oil, Microemulsion, stability, arthritis, pseudo ternary.

1. Introduction:

Essential oil has the hopeful potential for the treatment of Rheumatoid arthritis. Usually essential oil has low water solubility, high volatility and instability. For overcome these types of limitations microemulsion is the only approach for improving solubility, stability and permeability of the essential oil. In this study, Blue tansy oil was used to prepare microemulsion

2. Materials and method:

Blue tansy oil, Ethyl alcohol, Tween 80, Peanut oil and distilled water. All the ingredients were of analytical grade.

2.1 Pre-formulation studies

2.1.1 Organo-leptic properties

Organo-lepticproperties of an essential oil i.e. blue tansy oil were evaluated by visual examination on the basis of odour, colour and physical state of the sample (1).

2.1.2 Solubility studies

Solubility is an important characteristic of a compound which is important and need to be considered during formulation. It is well-defined as the volume of solute which is dissolved in a individual solvent at certain temperature (room temperature). The solubility of blue tansy oil was determined in different solvent according to the polarity. The solubility study was performed by using ethyl alcohol, n-hexane, acetone etc (2).

2.1.3 Specific-gravity

The essential oil specific-gravity was established by using the bottle technique. In this method the specific gravity bottle was used in which the bottle was filled with the identified capacity of the distilled or purified water at a definite temperature i.e. 20ºC and weighed. Then empty bottle was weighed and now bottle

was packed with essential oil and then weighed. The specific gravity was considered by:

Mass of the formulation $=W_3-W_1$, Mass of the distilled water = W_2-W_1

Specific gravity of formulation = $\frac{Mass\ of\ formuation}{mass\ of\ distilled\ water}$

Whereas, W3 = Bottle weight and formulation,

W2= Bottle weight and water,

W1= Weight of empty bottle

The process was repeated thrice, respectively (3,4).

2.1.4 Partition coefficient

The partition-coefficient was established through using shaking flask process. In this method both water and n-octanol was taken in ratio of 1:1 v/v i.e. 10ml: 10ml. Both n-octanol and water was incorporated in the orbital shaker. 5ml of blue tansy oil was also incorporated with the n- octanol and water. The reaction was kept for 24 hours in the shaker to achieve the equilibrium between the two phases. Separating funnel was used for separating the organic phase and aqueous phase (5). The funnel was kept stand for one day then the partition coefficient was calculated by using UV spectroscopy. The partition coefficient was determined by formula:

Partition coefficient = $\frac{Concentration\ of\ essential\ oil\ in\ organic\ phase}{Concentration\ of\ essential\ oil\ in\ aqueous\ phase}$

2.1.5 Compatibility study:

Compatibility study was done by mixing both essential oil and excipients for determination of physical and chemical changes. The essential oil and excipients were mixed in the ratio of 1:5, individually. They were stored in different temperatures like 5ºC, 25ºC and 40ºC for about one month. After one month the interaction between both essential oil and excipients were determined (6).

2.2 Formulation

2.2.1 Production of pseudo-ternary –phase-diagram

In current study, the pseudo- ternary-phase-diagram was created by consuming peanut oil (oil phase), Tween 80 (surfactant), aqueous phase (HPLC grade water) and ethanol (co-surfactant). However the method was using for construction of phase diagram was titration technique. In this technique both the surfactant and co-surfactant mixture (S-Co mix) was mixed in the ratio of 1:2 and 2:1. Furthermore, both the phases i.e. oil and aqueous phase was mixed in the ratio of 1:9 to 9:1. For construction of pseudo-ternary phase diagram the S-Co mixture was titrated in the mixture of oil and water phase with a drop-wise manner while the water and oil phase mix was rotating on the magnetic stirrer continuously in a whole process. Throughout titration, the phase activity of every ternary mixture was observed minutely. When the mixture turns turbid to clear solution it becomes our end point. The percentage concentration of the variable for every ternary structure was considered and results identified had been projected over triangular coordinates for creating phase diagrams (7).

2.2.2 Preparation of blue tansy oil microemulsion

Microemulsion regions were identified with the help of pseudo-ternary-phase-diagram and different types of preparations from this region have been selected for preparing the blue tansy oil microemulsion. Approximately 1%w/w of blue tansy oil was incorporated in the selected region of oil and water phase in a glass beaker. The S-Co mix was added dropwise in an oil and water level under continuous agitation using a magnetic stirrer for about 25-30 minutes. Here all the formulated microemulsions were left for one day and were again characterized and evaluated (8,9).

2.3 Evaluation:

2.3.1 Physical appearance

The prepared formulation was evaluated for the physical appearance i.e. turbidity or clear solution. The appearance of formulation was evaluated by visual examination (10).

2.3.2Specific gravity

The specific gravity of the prepared formulation was determined by the procedure in point 2.3.2

2.3.3 pH determination

For evaluating the pH value of the prepared formulation the Digital pH meter was used. The pH meter was adjusted with the pH solution of 4.0 and 7.0. pH of mixture had been calculated in triplicate and the mean values were determined (11).

2.3.4 Viscosity

The viscosity of the formulation was determined according to Sabale*et al*using the Brookfield viscometer. The spindle number-2 was sunk in a formulation and rotated at different rpm like 5, 10, 15, 20, 60 and 100 at room temperature. The calculated was evaluated three times (12).

2.3.5 Dynamic-light-scattering

The dynamic-light-scattering had been used for the determination of particle size via noticing casual changes in the intensity of light which is scattered from a formulation. The particle size was determined according to Goddeeris*et al*. The particles in formulation experience random thermal motion which is known as Brownian's law of motion. The random or casual motion was based on the equation of Stokes Einstein and the equation is used for determination of particle size by:

$$Dh = \frac{KBt}{3\pi\eta Dt}$$

Whereas,

Dt = translational diffusion-coefficient, Dh = hydrodynamic diameter, kB = Boltzmann's constant, η = dynamic viscosity, and T = thermodynamic-temperature (13)

2.3.6 Conductivity

The conductivity of microemulsion preparation was measured by using a digital conductivity meter with the precision. The constant conductivity cell was measured by using the regular KCL solution. Furthermore, the electrodes were submerged in microemulsion solutions at specific temperature until equilibrium has been reached and the reading becomes steady (14).

2.3.7 Stability analysis

The stability analysis was determined according to Torres *et al.*For experimental stability, alternative heating as well as cooling stages was applied for 1 day, at 40° C and 5°C, respectively, and were reported to the preparations selected from pseudoternary diagram during 2 weeks (15).

2.3.8 Gas-chromatography-Mass-spectroscopy

The gas-chromatography-mass-spectroscopy was used to evaluate the contamination and the constituents present in the formulation. It was determined according to Da Silva *et al*. In which the condition was set to be like the DB1 column capillary was used of 30m × 0.25mm and the thickness of film was 0.1µm. Injector was attached with temperature 280ºC and the temperature of Gas chromatography-mass spectroscopy interface was 300ºC. Furthermore the temperature of the column was designed as 100ºC kept for 3 min, and then improved to 180ºC at 2 ° C / min and to 300ºC at 5ºC / min. Helium gas could be castoff as a transporter just with a flow-rate 1 ml/min. The amount within each solution administered into gas chromatography-mass spectroscopy was 1 µL (16).

2.3.10 Statistical analysis

The data obtained from all the preparations was examined by ANOVA method.

3. Results and Discussion

3.1 Organo-leptic properties

The organo-leptic properties of blue tansy oil were evaluated by visual examination and expressed in Table 5.1:

Table 1: Organo-leptic properties

S.no	Parameters	Observation
1.	Colour	Dark blue
2.	Odour	Sweet and fruity
3.	Physical state	Liquid

3.2 Solubility studies

Table 2: The study of blue tansy oil was determined by different solvents in

S.no	Solvents/Oils	Soluble/Insoluble
1.	Ethyl alcohol	Soluble
2.	Water	Insoluble
3.	n-hexane	Soluble
4.	Peanut oil	Soluble
5.	Almond oil	Insoluble
6.	Coconut oil	Soluble

3.3 Specific-gravity

It was estimated by using bottle of specific gravity. It was calculated by:

Bottle weight, W1 = 24.12g
Bottle weight + Distilled water, W2 = 58.56g
Bottle weight + blue tansy oil, W3 = 55.12g
Mass of the blue tansy oil = W3-W1 = 55.12 - 24.12 = 31g
Mass of distilled water = W2-W1 = 58.56 – 24.12 = 34.44g
Specific gravity of blue tansy oil = Mass of blue tansy oil / mass of distilled water= 31/34.44 = 0.9 kg/m^3

3.4 Partition coefficient

The partition coefficient of blue tansy oil was calculated by using UV spectroscopy and the absorbance was expressed in Table 4:

Table 3: Absorbance of blue tansy oil in water:

Concentration (µg/ml)	Absorbance
1	0.206
2	0.423
3	0.641
4	0.834
5	0.998

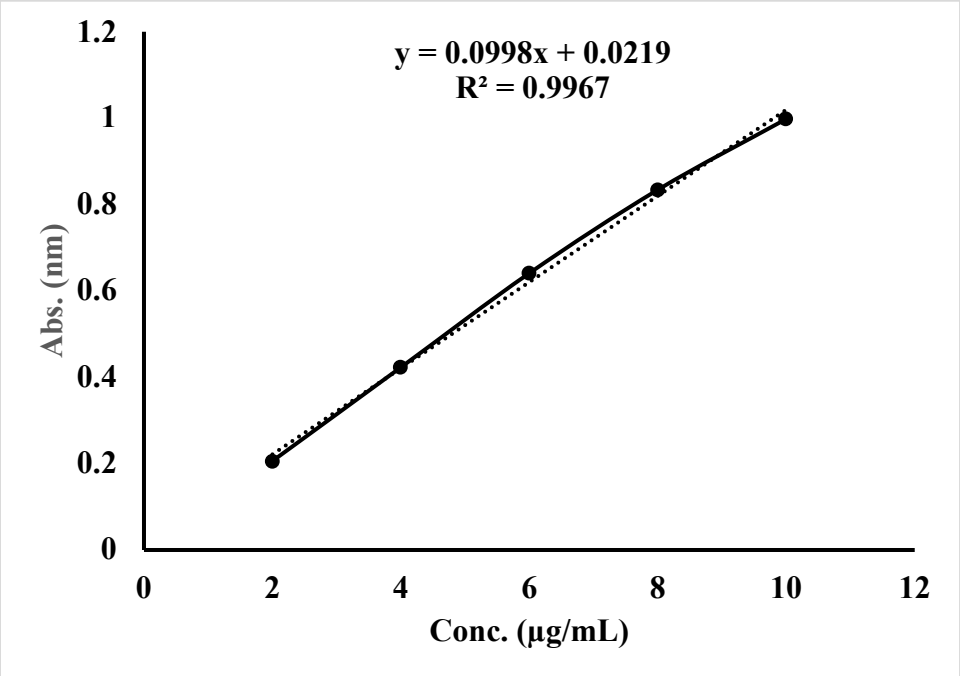

Figure 4: **The Standard curve of blue tansy in the water**

Furthermore the absorbance of the blue tansy oil in n-octanol was calculated by using UV spectroscopy as shown in Table 4.

Table 5: Absorbance of blue tansy oil in n-octanol

Concentration (µg/ml)	Absorbance
1	0.146
2	0.254
3	0.352
4	0.453
5	0.536

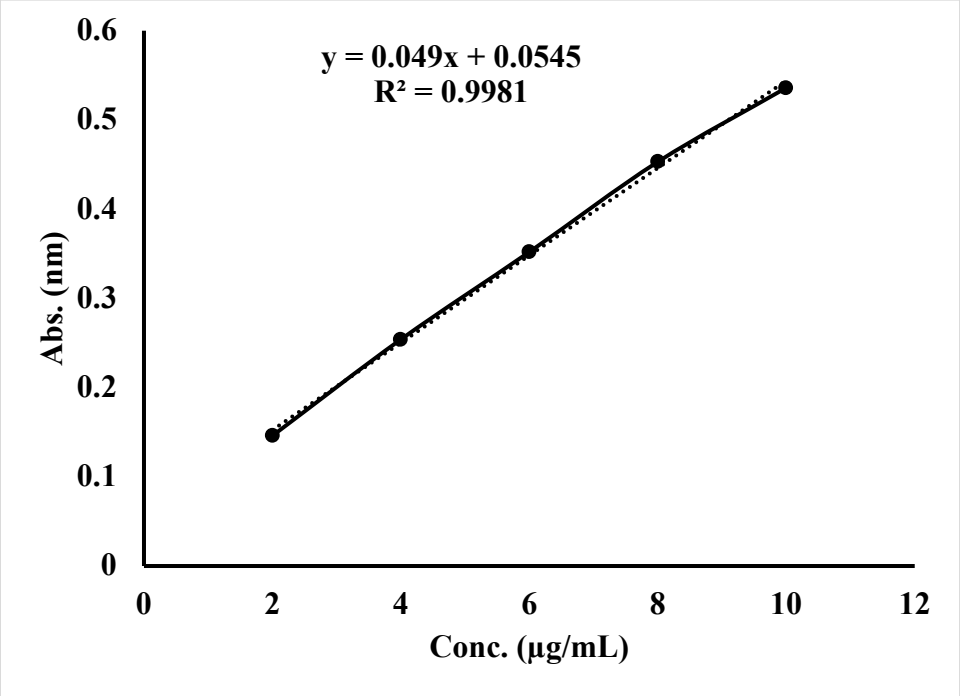

Figure 5: The Standard curve of blue tansy oil in the n-octanol

The concentration of essential oil in both water and n-octanol was calculated by using equation:

Blue tansy oil in water

y = mx+c

0.206 = 0.0998x+0.0219

X = 1.84

Blue tansy oil in n-octanol

y = mx+c

0.146 = 0.049x+0.0545

X = 1.86

Partition coefficient = $\frac{Concentration\ of\ essential\ oil\ in\ organic\ phase}{Concentration\ of\ essential\ oil\ in\ aqueous\ phase} = \frac{1.86}{1.84} = 1.01$

Pseudo-ternary-phase-diagram

The pseudo-ternary-phase-diagram was made for find out the region of microemulsion. The formulation compositions were shown below in table 5.6 and 5.7.

Table 5: In this table 1:1 and 2:1 surfactant and cosurfactant percentage was given:

S-Co mix	Oil (%w/w)	Water (%w/w)	S-COmix (%w/w)	% Oil	% water	%S-co mix
1:2	0.1	0.9	5.4	1.56	14.06	84.37
	0.2	0.8	6.6	2.63	10.52	86.84
	0.3	0.7	8.2	3.26	7.6	89.13
	0.4	0.6	10	3.63	5.45	90.9
	0.5	0.5	12	3.84	3.84	92.3
	0.6	0.4	13	4.28	2.85	92.8
	0.7	0.3	15.3	4.29	1.84	93.86
	0.8	0.2	18.4	4.12	1.03	94.84
	0.9	0.1	20	4.28	0.47	95.23
2:1	0.1	0.9	4.3	1.88	16.9	81.1
	0.2	0.8	5.4	3.12	12.5	84.3
	0.3	0.7	6.5	4	9.3	86.6
	0.4	0.6	7.3	4.81	7.22	87.9
	0.5	0.5	8.7	5.15	5.15	92.5
	0.6	0.4	9.8	5.55	3.70	90.74
	0.7	0.3	10.6	6.03	2.5	91.3
	0.8	0.2	11.9	6.20	6.20	92.2
	0.9	0.1	12.7	6.56	0.72	92.7

The pseudo-ternary-phase-diagram was presented for 1:1 and 2:1 in fig 5.3 and 5.4 given below.

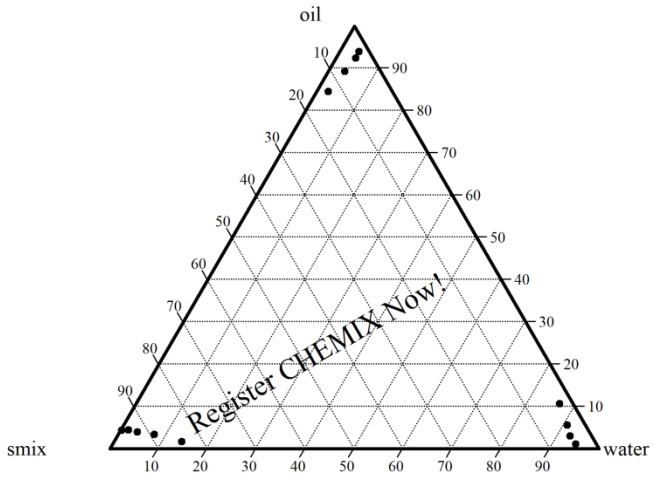

Figure 6: pseudo ternary phase diagram of 1:1 surfactant and co-surfactant ratio

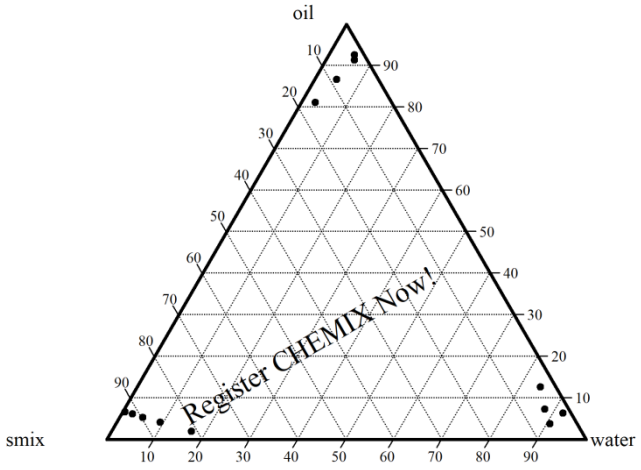

Figure 7: Pseudo-tern

4. Conclusion

Essential oil has the hopeful potential for the treatment of Rheumatoid arthritis. Usually essential oil has low water solubility, high volatility and instability. For overcome these types of limitations microemulsion is the only approach for improving solubility, stability and permeability of the essential oil.

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