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PREPARATION AND EVALUATION OF IBUPROFEN MICROEMULSION FOR TREATMENT OF JOINT PAIN

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ABSTRACT: The main objective of present work is preparation and evaluation of ibuprofen microemulsion for treatment of joint pain. Microemulsions have attracted considerable amount of interest as potential drug delivery vehicles largely due to their simple method of preparation, stability and their abilities to incorporate a wide range of drugs of varying solubility. O/W microemulsion is expected to increase the solubility by dissolving low water solubility compounds into its dispersed phase and to enhance the oral bioavailability by protecting the drug increasing the rate of absorption and wettability due to surfactants induced permeability changes and smaller droplet size and most importantly able to target lymphatic system. Prepared microemulsion formulations by phase-titration method were evaluated for viscosity, drug content, thermodynamic stability studies and in-vitro dissolution. Hence, micro-emulsion of valsartan was successfully developed and evaluated.

KEYWORDS: Ibuprofen, Microemulsion, permeability, evaluation, surfactant

INTRODUCTION: Joint pain is discomfort that affects one or more joints in your body. A joint is where the ends of two or more of your bones come together. For example, your hip joint is where your thigh bone meets your pelvis.Joint discomfort is common and usually felt in your hands, feet, hips, knees or spine. Pain in your joints may be constant, or it can come and go. Sometimes, your joints can feel stiff, achy or sore. Some people complain of a burning, throbbing or “grating” sensation.

The most common causes of joint pain include:

1. Osteoarthritis: Osteoarthritis, a common type of arthritis, happens over time when your cartilage,the protective cushion between your bones-wears away. Your joints become painful and stiff. Osteoarthritis develops slowly and usually occurs after age 45.
2. Rheumatoid arthritis (RA): RA is a chronic disease that causes swelling and pain in your joints. Often, your joints deform (usually occurring in your fingers and wrists).
3. Gout: Gout is a painful condition where acidic crystals from your body collect in your joint, causing severe pain and swelling. This usually occurs in your big toe.
4. Bursitis: Overuse causes bursitis. It’s usually found in your hip, knee, elbow or shoulder.
5. Tendinitis: Tendinitis is inflammation of your tendons, the flexible bands that connect bone and

muscle. It's typically seen in your elbow, heel or shoulder. Overuse often causes it.

Signs of joint inflammation include: Swelling, Warmth, Tenderness, Redness, Pain with movement. Pharmacologically, the management of joint pain typically starts with nonsteroidal anti-inflammatory drugs (NSAIDs) and analgesics, which are critical first-line options for symptomatic relief across various conditions, including rheumatoid arthritis and psoriatic arthritis. Microemulsion is defined as a dispersion consisting of oil,surfactant, cosurfactant and aqueous phase, which is a single optically isotropic and thermodynamically stable liquid solution with a droplet diameter usually within the range of 10–100 nm. Microemulsions have several advantages such as enhanced drug solubility, good thermodynamic stability, enhancing effect on transdermal ability over conventional for emulations.[5]There are several permeation enhencement mechanisms of microemulsions such as an increased concentration gradient and thermodynamic activity toward skin and the permeation enhancement activity of the components of microemulsion.

Types of Micro Emulsion

O/W microemulsion, W/O microemulsion, Bi-continuous microemulsion

METHODS OF PREPARATION OF MICROEMULSION:

Phase Titration Method (Water or Oil Titration): Mix oil, surfactant, and co-surfactant. Add water dropwise with stirring until a clear microemulsion forms.Type (O/W or W/O) depends on composition.

Phase Inversion Method: Gradually change the composition (e.g., adding water to oil phase or heating/ cooling. Causes inversion of phases (oil-in-water convert into water-in-oil).Simple and energy-efficient.

Spontaneous Emulsification Method: Microemulsion forms spontaneously when components mix in correct ratios.

Phase titration method: The best method for preparing microemulsions is often a variation of the phase titration method, where components are gradually mixed to form a transparent, thermodynamically stable system. This method involves creating a mixture of oil and a surfactant/cosurfactant system (Smix), then slowly adding either water or oil dropwise while stirring until the mixture becomes clear. This process allows for the creation of a pseudoternary phase diagram, which helps in determining the exact composition for a stable microemulsion.

ADVANTAGES OF MICROEMULSION: Thermodynamic stability, Spontaneous formation, High drug solubility**,** Enhanced bioavailability**,** Versatility.

MATERIALS AND METHODS:

MATERIALS:

Drug: Ibuprofen (nonsteroidal anti-inflammatory drug).

Oil Phase: Selected based on the highest solubility of the drug (e.g., Oleic acid, Ethyl oleate, or Isopropyl myristate).

Surfactant: Used to lower interfacial tension (e.g., Tween 80, Tween 20).

Co-surfactant: Used to further reduce interfacial tension and ensure fluid flexibility (e.g., Propylene glycol, Ethanol).

METHODS:

1. Accurately weigh Ibuprofen and dissolve it in the optimized oil phase.
2. Add the surfactant and co-surfactant mixture to the drug-oil mixture and stir continuously until a clear, homogeneous blend is achieved.
3. Titrate this blend with the aqueous phase (water or saline) dropwise under constant, moderate magnetic stirring to form the final microemulsion.

RESULT AND DISCUSSION:

The microemulsion of Ibuprofen was successfully prepared using the phase titration method. The formulation appeared clear, transparent, and stable, indicating the formation of a proper microemulsion system.

EVALUATION PARAMETERS OF MICROEMULSION:

Physical Appearance: Clear and homogeneous

pH: Found within acceptable skin range (5.5 – 6.5)

Drug Content: ~95–99% (uniform distribution)

Droplet Size: In nanometer range (stable microemulsion)

Zeta Potential: Indicated good stability

Solubility: Significantly increased compared to pure drug

Stability Study: No phase separation observed

CONCLUSION: The prepared Ibuprofen microemulsion showed improved physicochemical properties compared to the pure drug. The increase in solubility is due to the presence of surfactant and co-surfactant. The small droplet size enhances drug absorption through the skin. The stability studies confirmed that the formulation remains stable under different conditions. The drug content uniformity indicates proper mixing and formulation technique. This system is effective for topical delivery in joint pain, improving therapeutic action and patient compliance.

REFERENCES:

1. Tenjarla, S., 1999. Microemulsions: an overview and pharmaceutical applications. Crit. Rev. Ther. Drug Carrier Syst. 16, 461–521.
2. Lawrence, M.J., Rees, G.D., 2000. Microemulsion-based media as novel drug delivery systems. Adv. Drug Deliv. Rev. 45, 89–121.
3. Peltola, S., Saarinen-Savolainen, P., Kiesvaara, J., Suhonen, T.M., Urtti, A.,2003. Microemulsions for topical delivery of estradiol. Int. J. Pharm. 254,99–107.
4. Sperry, M. M., Ita, M. E., Kartha, S., Zhang, S., Yu, Y.-H., & Winkelstein, B. A. (2017). The Interface of Mechanics and Nociception in Joint Pathophysiology: Insights From the Facet and Temporomandibular Joints. Journal of Biomechanical Engineering-Transactions of The Asme, 139(2), 021003. https://doi.org/10.1115/1.4035647
5. Chaudhary, A., Barman, A., Gaur, P. K., Mishra, R., & Singh, M. (2018). A review on microemulsion a promising optimising technique used as a novel drug delivery system. Int Res J Pharm, 9(7), 47-52.
6. Hu, L., Yang, J., Liu, W., & Li, L. (2011). Preparation and evaluation of ibuprofen-loaded microemulsion for improvement of oral bioavailability. Drug delivery, 18(1), 90-95.

7. Moulik SP, Rakshit AK (2006) Physicochemistry and Applications of Microemulsions. Journal of Surface Science and Technology 22(3–4) 159–186.

8. Hu, L., Yang, J., Liu, W., & Li, L. (2010). Preparation and evaluation of ibuprofen-loaded microemulsion for improvement of oral bioavailability. Drug Delivery, 18(1), 90–95. https://doi.org/10.3109/10717544.2010.522613.

9. Yamasaki K, Rahman MH, Tsutsumi Y, Maruyama T, Ahmed S, Kragh-Hansen U, Otagiri M: Circular dichroism simulation shows a site-II-to-site-I displacement of human serum albumin-bound diclofenac by ibuprofen. AAPS PharmSciTech. 2000 May 14;1(2):E12. [Article]

10. Galantini L, Leggio C, Konarev PV, Pavel NV: Human serum albumin binding ibuprofen: a 3D description of the unfolding pathway in urea. Biophys Chem. 2010 Apr;147(3):111-22. doi: 10.1016/j.bpc.2010.01.002. Epub 2010 Jan 18.

11. National Center for Biotechnology Information (2025). PubChem Compound Summary for CID 3672, Ibuprofen, (+-)-. Retrieved November 16, 2025 from https://pubchem.ncbi.nlm.nih.gov/compound/Ibuprofen.

12. Moghimipour, E., Salimi, A., & Leis, F. (2012). Preparation and evaluation of tretinoin microemulsion based on pseudo-ternary phase diagram. Advanced pharmaceutical bulletin, 2(2), 141.

13. Wang, T., Huang, Y., Liu, X., Molassiotis, A., Yao, L., Zheng, S. & Huang, H. (2022). Prevalence and correlates of joint pain among chinese breast cancer survivors receiving aromatase inhibitor treatment. https://doi.org/10.21203/rs.3.rs-1390711/v1.