Liposomal Hydrogel Formulations for the Transdermal Delivery of NSAIDs: Development and Current Status

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Nonsteroidal Anti-Inflammatory Drugs

- ❑ Type of medication that treats pain and fever from a variety of conditions
- ❑ Available over-the-counter (OTC) and by prescription
- ❑ Common NSAIDs are ibuprofen, diclofenac, and naproxen
- ❑ All NSAIDs most common adverse effect is gastrointestinal (GI) bleeding
- ❑ Food & Drug Administration (FDA) warns risk of stomach problems goes up
  - when taken everyday or regularly
  - for people older than 65 years old
  - people with a history of stomach ulcers
  - people who take blood thinners.
- ❑ Topical administration is an advantage over common oral administration
  - to reduce GI problems
  - deliver the drug more selectively to a specific site
  - avoid first pass effect of the liver
  - improve patience compliance.

Liposomal Hydrogel Formulations

- ❑ Transdermal Drug Delivery (TDD) is the diffusion of drugs through the layers of the skin and into the bloodstream to provoke a systemic effect
  - challenged by the outermost layer of the skin, stratum corneum (SC)
- ❑ A widely employed approach is the use of elastic liposomes
  - biocompatible and deformable vesicular carriers
  - lipid bilayer/s enable encapsulation of hydrophilic and lipophilic drugs
  - properties vary and depend on many factors
    - lipid composition, surface charge, size, and method of preparation
- ❑ Despite their superior benefits, some shortcomings have been revealed
  - chemical & physical instability, rapid degradation, short life
- ❑ Liposomes can be incorporated in polymeric matrices like hydrogels
- ❑ Hydrogels are another suitable approach for topical drug administration
  - absorb water similar than body tissues
  - can encapsulate therapeutic molecules
  - biocompatible and biodegradable
- ❑ Hydrogels may present burst release effect which causes toxicity
- ❑ Combination of liposomes and hydrogels for TDD enhances
  - vesicle stability & drug release
  - transdermal permeability
  - localization of the drug in the skin

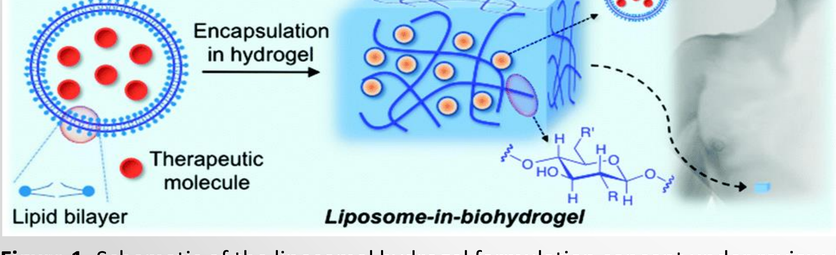


Figure 1. Schematic of the liposomal hydrogel formulation concept under review. [6]

Literature Review Construction

Materials

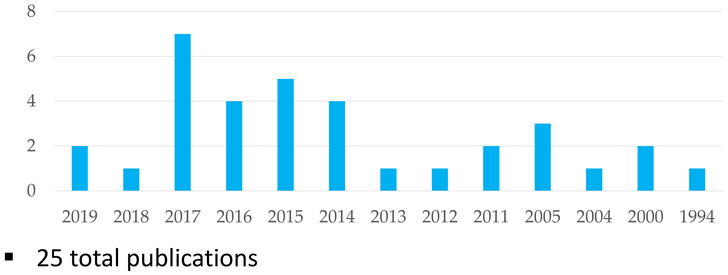
- ❑ Available literature concerning the scope of this review is browsed using the *Google Scholar* and *PubMed* search engines.
- ❑ Articles are filtered using keywords
  - Liposomes | hydrogel | transdermal/topical delivery | NSAIDs

Methodology

- ❑ Existing reviews of liposomes, hydrogels, and TDD of NSAIDs were examined to determine a unique focus for this investigation
- ❑ Articles involving research findings on liposomal hydrogel formulations for NSAIDs transdermal delivery will be analyzed to extract data and information
- ❑ Technologies and advances, as well as areas that require further study, will be reported

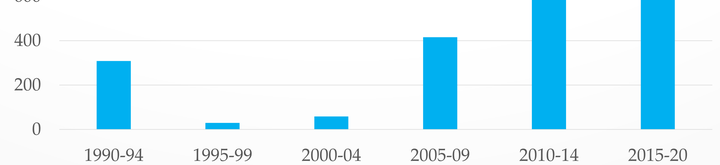
Preliminary Results

- ❑ *PubMed* search results by year for "liposome" "hydrogel" "NSAIDs"



- 25 total publications
  - 6 literature reviews; 1 relevant to pain therapy through TDD
  - 19 research articles; 14 relevant to liposomal hydrogel NSAIDs
- Diclofenac was the most studied (3 articles) NSAID in liposomal hydrogel formulations
- Other NSAIDs were studied at least one time
  - Ibuprofen, flurbiprofen, ketoprofen
  - Lornoxicam, piroxicam, meloxicam
  - Indomethacin, aceclofenac

- ❑ *Google Scholar* gave 2,140 search results for "liposome" "hydrogel" "NSAIDs" "transdermal" for the years 1990 – 2020 after blocking keywords for common non-relevant results



Status

*** The present investigation is still ongoing ***

- ❑ *PubMed* relevant articles are being read and analyzed in order to extract the necessary information
- ❑ *Google Scholar* results will be narrowed down with time filters and most recent articles will be inspected first

Timeframe	Articles
2005 – 2009	416
2010 – 2014	725
2015 – 2020	594

  - *GS* articles will be inspected in the order of relevance determined by the search engine based on the use of the keywords
  - Relevant results will be saved to be read and analyzed in order to extract the necessary information
  - Data will be organized by NSAID used to test formulation properties
- ❑ Relevant articles from both, *PubMed* and *Google Scholar,* will be taken into consideration for the construction of the literature review
- ❑ Literature review will have the following structure:
  - Introduction on NSAIDs, TDD, Liposomes, and Hydrogels
  - Formulation developments per NSAIDs studied and tested
  - Similar relevant information
  - Major conclusions on the development and current status

References

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