DESIGN AND PERMEATION STUDIES OF ALGINATE MULTIPARTICULATE SYSTEMS FOR TRANSDERMAL DRUG DELIVERY

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INTRODUCTION

Polymers prepared from renewable natural resources are becoming increasingly used because of their low cost, availability, water-solubility, biocompatibility, biodegradability, mucoadhesive properties and gel forming properties. Such materials are ideal for the encapsulation technology, and controlled release can be achieved by these drug carriers, that exhibit either permeation enhancement features or protective properties.

This study was conducted with a natural polymer- alginate- elected because it is non-toxic, with broad spectrum of use, widely available and with high quality. Two model drugs were selected for encapsulation: one hydrophilic (caffeine), and another with a lipophilic nature (ibuprofen).

METHODS

The model permeants were separately encapsulated into dry or hydrated alginate beads. Ibuprofen was also encapsulated in microparticles. Additionally, and for comparative purposes, free drug was included in two conventional formulations- a gel and/or an O/W cream. In vitro diffusion studies with Franz cells were conducted, using silastic as a model membrane (75mm thickness). Equal amounts of the different formulations, were placed in the donor compartment of the diffusion cells. The multiple steady-state fluxes of caffeine and ibuprofen were determined.

RESULTS

The encapsulation efficiency achieved in the preparation of both dry and hydrated beads was around 40%. The beads were uniform in shape and size (Figure 1) and had a mean diameter of 2-3 mm (hydrated) and 1 mm (dry)alginate microparticles (mean diameter 45 µm).. Results indicate that the release rate of caffeine was higher from the dry beads and the O/W cream and lowest from the hydrated beads (Figure 3 and Table 1).

Both types of alginate particles were successfully produced (Figure 2) and a good encapsulation efficiency of ibuprofen was obtained with macro and microparticles (around XXX%). Diffusion studies revealed significant differences in the permeation of ibuprofen from the different systems (Figure 4). The highest fluxes were obtained from the dry macroparticles and the lowest from the microparticles and the hydrated macroparticles. The gel provided intermediate fluxes (Table 1).

CONCLUSION

Results indicate that the encapsulation technology can be successfully applied to modulate the bioavailability of drugs with both a hydrophilic and lipophilic nature for transdermal administration. Further studies will be conducted with human skin, followed by work with more therapeutically relevant drugs.

ACKNOWLEDGEMENTS

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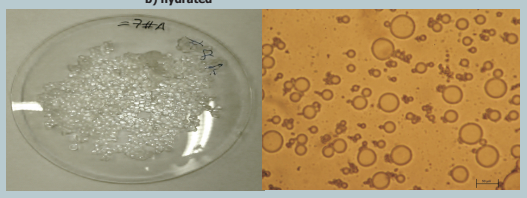
a) b)

Figure 1- Caffeine loaded alginate beads
a) dry
b) hydrated



a) b)

Figure 2- Ibuprofen loaded alginate particles
a) beads
b) microparticles

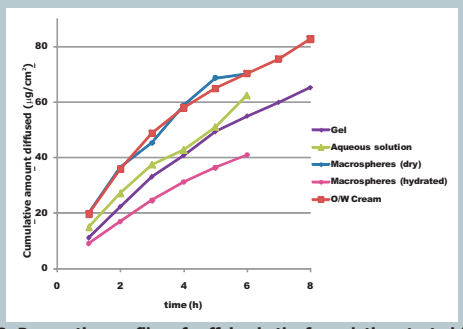


Figure 3- Permeation profiles of caffeine in the formulations tested (mean values, n=4)

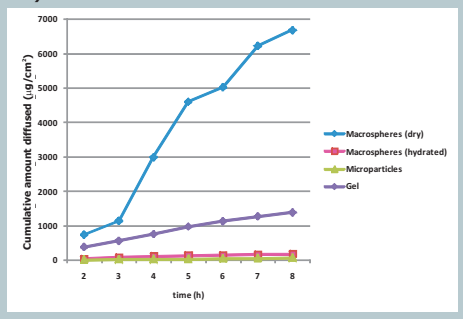


Figure 4- Permeation profiles of ibuprofen in the formulations tested (mean values, n=5)

Table 1- Steady-state fluxes in the different formulations (mean±SD)

DRUG	FORMULATION	FLUX (µg/cm²/h)
CAFFEINE	GEL	7.61 0.81
	O/W CREAM	8.46 1.75
	AQUEOUS SOLUTION	8.99 0.97
	MACROSPHERES (DRY)	10.33 3.13
	MACROSPHERES (HYDRATED)	6.42 0.39
IBUPROFEN	GEL	170.16 18.94
	MACROSPHERES (DRY)	1164.72 119.91
	MACROSPHERES (HYDRATED)	21.82 1.48
	MICROPARTICLES	8.83 2.89

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