Microsponges as Innovative Drug Delivery Systems


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ABSTRACT

Transdermal drug delivery system (TDDS) is not practicable for delivery of materials whose final target is skin itself. Controlled release of drugs onto the epidermis with assurance that the drug remains primarily localized and does not enter the systemic circulation in significant amounts is a challenging area of research. Microsponges are highly porous micro-sized particles with a unique ability for entrapping active pharmaceutical ingredients. To control the delivery rate of active agents to a predetermined site in human body has been one of the biggest challenges faced by scientists.

Microsponges are safe biologically and offer unique advantage of programmable release. This technology offers entrapment of ingredients and is believed to contribute towards reduced side effects, improved stability, increased elegance and enhanced formulation flexibility. This technology is being used for topical formulations and also for oral administration. The present review describes microsponge technology including its preparation, characterization, programmable parameters and release mechanism of microsponge drug delivery system.

KEY WORDS: Microsponges; transdermal drug delivery; programmable release; topical formulation; oral administration.

Introduction

To control the delivery rate of active agents to a predetermined site in the human body has been one of the biggest challenges faced by pharmaceutical scientists. Several predictable and reliable systems have been developed for systemic delivery of drugs under the heading of transdermal delivery system (TDS) using the skin as portal of entry. It has improved the efficacy and safety of many drugs that may be better administered through skin. But TDS is not practicable for delivery of materials whose final target is skin itself (Kydonieus and Berner, 1987). Controlled release of drugs onto the epidermis with assurance that the drug remains primarily localized and does not enter the systemic circulation in significant amounts is a challenging area of research.

Topical application of drugs suffers many problems. Ointments, which are often aesthetically unappealing faces the problems like greasiness, stickiness and often result in lack of patient compliance. These vehicles require high concentrations of active agents for effective therapy because of the low efficiency of delivery system, resulting into irritation and allergic reactions in significant users. Other drawbacks of topical formulations are uncontrolled evaporation of active ingredient, unpleasant odour and potential incompatibility of drugs with the vehicles. Thus, there exists the need for system to maximize amount of time that an active ingredient is present either on skin surface or within the epidermis, while minimizing its transdermal penetration into the body.

The microsponge delivery system fulfills these requirements. Microsponges are porous microspheres having myriad of interconnected voids of particle size range of 5-300 µm. These microsponges have capacity to entrap wide range of active ingredients such as emollients, fragrances, essential oils, sunscreens, and anti-infectives and are used as a topical carrier system. Further these porous microspheres with active ingredients can be incorporated into formulations such as creams, lotions and powders (Vyas and Khar, 2002).

Microsponges consist of non-collapsible structures with porous surface through which active ingredients are released in controlled manner (Fig.1). Depending upon the size, the total pore length may range up to 10 ft and pore volume up to 1 ml/g. When applied to the skin, the microsponge drug delivery system (MDS) releases its active ingredient on a time mode and also in response to other stimuli such as rubbing, temperature, and pH (Vyas and Khar, 2002).

Microsponges have the capacity to adsorb or load a high degree of active materials into the particle or onto its surface. Its large capacity for entrapment of actives up to 3 times its weight differentiates microsponges from other types of dermatological delivery systems.

The fundamental appeal of the microsponge technology stems from the difficulty experienced with conventional topical formulations in releasing active ingredients over an extended period of time. Cosmetics and skin care preparations are intended to work only on the outer layers of the skin. Yet, the typical active...