

# An Alternative System Based on Hydrogels of Ivermectin for the Treatment of Cutaneous Leishmaniasis †

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**Abstract:** Leishmaniasis is a neglected tropical disease whose cutaneous form manifests as ulcers or nodules. Currently, the chemotherapy arsenal against infections with different forms of leishmaniasis lacks security. Thus, drug repositioning can be a valuable R&D (Research and experimental development) strategy. The aim of this work was the development and evaluation of thermosensitive ivermectin hydrogels (IVM) as an alternative treatment. Poloxamers 407 and 188 hydrogels with different concentrations of IVM were prepared rheologically characterized to determine the sol-gel transition temperature and their viscoelastic behavior as a function of temperature. IVM release profiles were obtained and mathematically analyzed using the Lumped model. Pharmaceutical parameters such as the time required to reach 80% of the dissolved drug ( $t_{80\%}$ ) and the dissolution efficiency (DE) were also calculated. It was observed that the hydrogels allowed modulation of the release of IVM. The formulation containing 1.5% w/w IVM was the most suitable. It had an adequate gelation temperature (26.99 °C), an optimal complex viscosity (35.7 Pa.s), and a low elastic modulus (212.6 Pa) at 25 °C. On the other hand, the  $t_{80\%}$  and the DE were 95 min and 14.6%, respectively. The hydrogels modulated the release of IVM. These systems are a promising alternative to improve the treatment of cutaneous leishmaniasis.

**Keywords:** leishmaniasis; ivermectin; hydrogels; Lumped model; repositioning of drugs.

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### **Conflicts of Interest**

The authors declare no conflict of interest.