Development and characterization of a liposomal nanosystem as a carrier for a water-soluble antiparasitic for veterinary use

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Gastrointestinal parasitosis in livestock represents one of the most significant health and economic challenges for the sector, exacerbated by the development of resistance to conventional drugs in recent decades. In this context, nanotechnology offers various delivery and release platforms; among them, liposomes stand out as a promising strategy. These lipid nanosystems allow the encapsulation of the active ingredient within their aqueous compartment, which could significantly improve its bioavailability and therapeutic efficacy, while simultaneously helping to mitigate the risk of parasite resistance.

In this work, analytical techniques were developed for the quantification of a water-soluble antiparasitic, followed by the synthesis and physicochemical characterization of its liposomal formulation. The liposomes were obtained using the soy phosphatidylcholine (SPC) thin-film hydration method and processed by extrusion to obtain unilamellar vesicles. To determine the encapsulation efficiency (EE%), the non-encapsulated drug was separated from the formulation using centrifugal-ultrafiltration (AMICON® 100 kDa MWCO). The EE% was calculated by quantifying the drug retained within the liposomes after solvent-induced disruption with DMSO, using UV-Vis spectroscopy. A linear calibration curve was used for quantification (R^2 = 0.9918) and the nanosystem reached an EE% above 20%. Initial characterization of the nanosystem revealed good colloidal stability: over a four-week period, the hydrodynamic diameter remained below 200 nm with a polydispersity index (PDI) close to 0.1. This colloidal stability was further assessed using Turbiscan analysis at 25 °C and 37 °C, showing a Turbiscan Stability Index (TSI) below 2.2 during the period studied. Morphology was analyzed via electron microscopy. Thermal properties, including phase transition temperature and the enthalpy associated with this process, were also analyzed using Differential Scanning Calorimetry (DSC).

In conclusion, the developed methodology enables the preparation of liposomes with consistent size, polydispersity, and encapsulation efficiency, supporting their use for the delivery of hydrophilic drugs. These results establish a solid basis for further optimization of antiparasitic formulations in veterinary applications.