Chronic skin wounds are increasing in western countries due to the aging of population and to the increased incidence of illnesses such as diabetes. Wounds can be colonized by pathogens that delay the natural healing process and worsen the health of the patient. Hence, the therapeutic need to treat wounds with antibiotics preferentially with topical formulations with proper characteristics, in order to avoid systemic toxicity, wound occlusion and device traumatic removal. In this work a new powder formulation based on pectin/bovine serum albumin (PCT/BSA) loaded gentamicin sulfate (GS) as antibiotic model has been produced. Such formation, able to gel when in contact with wound exudates and to adapt to the wound bed can be a promise alternative to conventional devices. Powders were produced with innovative technology such as Supercritical Assisted Atomization (SAA) that uses supercritical CO$_2$ as fluid process. This technique has shown to be able to produce microparticulate powders with high yield (73-82%), and very high encapsulation efficiency, due to the so called anti-solvent effect. Chemico-physical characterization using different techniques was performed on all produced powders, and, as a result, formulations showed proper size and dressing characteristics as appropriate transpiration and conformability, and prolonged gentamicin release, up to 15 days, in vitro. Moreover, GS intensive release in the first 6 hours of administration could be very useful to prevent infection spreading at the beginning of a local antibiotic therapy. Furthermore, microbiological assays confirmed prolonged activity of PCT/BSA formulations (till 24 days versus 7 days of GS) against *Staphylococcus aureus*.