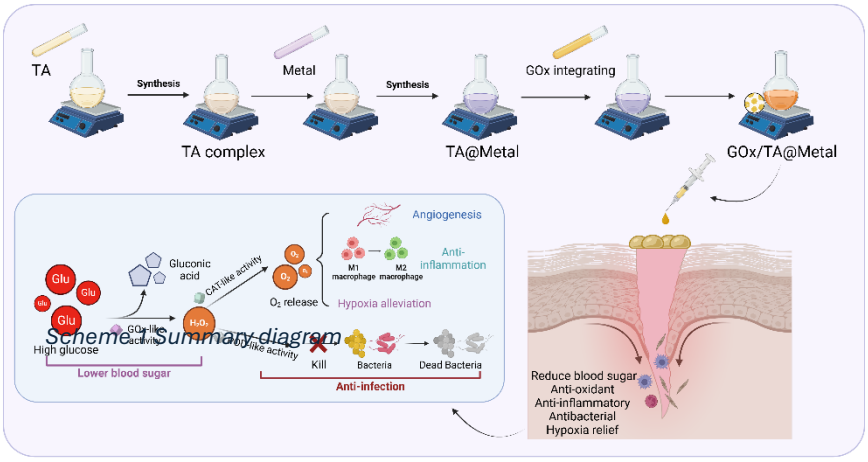
Construction of cascade nanozyme system

Effective glycemic control is paramount for optimal wound healing in diabetic patients. Traditional antibacterial and anti-inflammatory treatments, while important, often fall short in addressing the hyperglycemic conditions of diabetic wounds. Besides, the low efficiency of H_2O_2 self-decomposition and the damage to healthy tissues caused by high-dose H_2O_2 disinfection of wounds limit the recovery of the wound. Thus, the development of novel therapeutic strategies for accelerating diabetic wound healing has garnered escalating attention. Nanozymes, as a type of nanomaterials with biological enzyme characteristics, can improve the detrimental microenvironment of diabetic wounds by performing different kinds of enzyme-like activities, which have good potential in the treatment of diabetic wounds. Among the different kinds of enzymatic activities, glucose oxidase (GOx) can continuously oxidize the nontoxic and biocompatible glucose to generate hydrogen peroxide (H_2O_2) and gluconic acid. And the resulting H_2O_2 can be subsequently broken down into •OH via POD-like activity or O_2 via CAT-like activity, separately. The cascade reaction system not only reduces glucose levels but also helps to lower excess ROS and supply a continuous supply of O_2. In a word, the full utilization of blood glucose and the breakthrough of local pH and H_2O_2 limitations can improve the therapeutic efficacy for hyperglycemic wound sterilization. Based on the above, the purpose of this project is to prepare a cascade nanozyme reaction system. To achieve this goal, several steps must be taken:

A) Synthesize TA-based nanozyme and integrate it with natural enzymes GOx.
B) Characterize the integrated nanozyme and evaluate its multienzyme-like activities.
C) Evaluate the biocompatibility, antioxidant, anti-inflammatory, and antibacterial activities in vitro.



Scheme. Summary diagram.

Related literature:
https://doi.org/10.1016/j.redox.2024.103217
https://doi.org/10.1021/acsnano.3c04134
https://doi.org/10.1002/adhm.202301474
https://doi.org/10.1016/j.jconrel.2024.06.040

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