UNIVERSITI TEKNOLOGI MARA

INTEGRATION OF HYPERELASTIC CONSTITUTIVE MODELS IN HYBRID BIOMATERIAL FOR WOUND HEALING APPLICATION

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Various type of healing patch in the current market such as acne patch were used daily to reduce bacteria on the wounded area. Desired characteristics of wound dressing are good absorption rate, reduce healing time and equipped with an antibacterial agent. In this project, a perfect balance composition between natural biopolymer and mechanical properties on the new wound-healing material is complicated to explicate. This research focuses on the study of basic mechanical and biomechanical properties of the material for a healing patch application with a new composition of biodegradable ingredients by using the estimation of hyperelastic models to fit with the experimental data. This project was started with material selection divided into three sets. Secondly, the three sample sets undergo a uniaxial tensile test to obtain the raw data. For numerical phases, the conventional theory of large deformation based on hyperelastic constitutive equations and Stress-Strain Energy Theory were identified. The final step for this project is curve fitting between experimental data (Ogden and Mooney-Rivlin hyperelastic models). From the hyperelastic theory, new parameters were carried out for healing patch materials made of hybrid nanogelatin biomaterials. Most of the curve fit presented were follow the trends but there are slight differences due to different composition of the material. Based on the three sample sets (Set A, Set B, Set C), the best texture as artificial skin or healing patch is Set B. The Set B samples consist of gelatin, glycerine, distilled water and aloe vera. For Ogden hyperelastic model, the highest material constants obtained were α=1.8792 μ=0.1881 MPa from Set B respectively with 500mm/min tensile speed. The highest material constants of Mooney-Rivlin obtained were C_1=0.0746 C_2=0.1294 from Set C respectively with 500 mm/min tensile speed. Based on curve fitting presentation, Ogden model is the suitable reference for producing the future healing patch. As a conclusion, the suitable composition of a healing patch was identified, the effect of basic mechanical and biomechanical properties was explicated, and the parameter differences between hyperelastic models were calculated. Therefore, the objectives were achieved successfully. The significance of this project is we could reduce the exploitation of animal or human skin for experimental skin purposes. In additions, the new technology could be improved in the medical area with biodegradable and sustainable sources of healing patch.

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