Karakterisasi Fisika Kimia Perancah Hydrogel Berbasis Polyvinyl Alcohol-Gelatin-Human Amniotic Membrane untuk Cardiac Patch = Physicochemical Characterization of Polyvinyl Alcohol-Gelatin-Human Amniotic Membrane Based Hydrogel Scaffold for Cardiac Patch

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Abstrak

Penyakit jantung menyebabkan sekitar 7 juta kematian setiap tahun akibat infark miokard yang menjadi penyebab utama morbiditas dan mortalitas. Dengan kemampuan terbatas jantung untuk meregenerasi diri, diperlukan strategi terapi efektif untuk pemulihan fungsi miokard pasca infark miokard. Penelitian ini berfokus pada karakterisasi fisika kimia hydrogel berbasis PVA-gelatin-hAM untuk menargetkan terapi infrak miokard. Hydrogel berbasis PVA-gelatin-hAM difabrikasi menggunakan metode freeze-thaw dengan 2 siklus. Karakterisasi hydrogel yang dilakukan meliputi FTIR, DSC, swelling, compression, reologi, dan SEM. Hasil uji FTIR menunjukkan adanya pembentukan ikatan silang dalam matriks hydrogel. Penambahan gelatin dan hAM terbukti dapat menurunkan melting temperature PVA. Hydrogel PVA-Gel-hAM menunjukkan nilai swelling ratio yang paling rendah. Nilai kuat tekan pada PVA, PVA-Gel, PVA-hAM, dan PVA-Gel-hAM secara berurutan sebesar 1,359 ± 0,0730 MPa, 0,7678 ± 0,1020 MPa, 0,3399 ± 0,01930 MPa, dan 0,5892 ± 0,05662 MPa. Hasil uji reologi dengan frequency sweep menunjukkan bahwa storage modulus lebih tinggi daripada loss modulus pada seluruh hydrogel berbasis PVA-gelatin-hAM. Hasil uji SEM menunjukkan tidak terdapat perbedaan signifikan dalam morfologi antara hydrogel PVA, PVA-Gel, dan PVA-Gel-hAM, meskipun hydrogel PVA-hAM memiliki morfologi berserat yang khas kolagen. Penelitian hydrogel berbasis PVA-Gelatin-hAM merupakan yang pertama kali dilakukan. Hal ini menjadi kontribusi baru dalam bidang hydrogel untuk cardiac patch.

.....Cardiovascular disease results in approximately 7 million deaths annually, primarily due to myocardial infarction, which is a leading cause of morbidity and mortality. Given the heart's limited regenerative capacity, there is a pressing need for effective therapeutic strategies to restore myocardial function post-myocardial infarction. This research focuses on the physicochemical characterization of a PVA-gelatin-hAM-based hydrogel for myocardial infarction therapy. The hydrogel was fabricated using a freeze-thaw method over two cycles. Characterization techniques included FTIR, DSC, swelling tests, compression tests, rheological analysis, and SEM. FTIR results indicated the formation of cross-links within the hydrogel matrix. The addition of gelatin and hAM significantly reduced the melting temperature of PVA. The PVA-Gel-hAM hydrogel exhibited the lowest swelling ratio among the samples. The compressive strength values for PVA, PVA-Gel, PVA-hAM, and PVA-Gel-hAM were 1.359 ± 0.0730 MPa, 0.7678 ± 0.1020 MPa, 0.3399 ± 0.01930 MPa, and 0.5892 ± 0.05662 MPa, respectively. Rheological tests using frequency sweep analysis demonstrated that the storage modulus was consistently higher than the loss modulus across all PVA-gelatin-hAM-based hydrogels. The SEM analysis shows no significant difference in morphology between PVA hydrogel, PVA-Gel, and PVA-Gel-hAM, despite PVA-hAM hydrogel exhibiting a characteristic collagen-like fibrous morphology. This pioneering study on PVA-Gelatin-hAM-based hydrogels represents a novel contribution to the field of hydrogels for cardiac patch applications.