

“Evaluation of biopolymers for the application in wound care”

“Evaluierung von Biopolymeren für die Anwendung in der Wundheilung”

Dissertation

zur Erlangung des akademischen Grades doctor rerum naturalium

(Dr. rer. nat.)

vorgelegt dem Rat der Chemisch-Geowissenschaftlichen Fakultät
der Friedrich-Schiller-Universität Jena

von Dipl.-Biochem. *Cornelia Wiegand*
geboren am 17.11.1980 in Apolda

	page
1. Introduction	3
2. Application of biopolymers in wound healing – state of the art	7
2.1 Physiology of chronic wounds	7
2.2 Treatment of chronic wounds	12
2.3 Promising biopolymers for wound healing	16
2.3.1 Cellulose (oxidized regenerated cellulose and microbial cellulose)	16
2.3.2 Collagen	18
2.3.3 Alginate	22
2.3.4 Chitosan	25
3. <i>In vitro</i> evaluation of requirements for biomaterials	30
3.1 Biocompatibility	30
3.1.1 Measurement methods for cell proliferation, cytotoxicity, and induction of apoptosis	30
3.1.2 Determination of the effect of biopolymer-based wound dressings on keratinocyte and fibroblast cell growth	34
3.1.3 Induction of apoptosis by low concentrations of chitosans with different molecular weight in the human keratinocyte cell line HaCaT and in primary human keratinocytes and fibroblasts	39
3.2 Moist wound healing (inactive and interactive wound dressings)	49
3.2.1 Management of wound exudate	49
3.2.2 Determination of the antimicrobial activity of alginate wound dressings according to the Japanese Industrial Standard (JIS L 1902: 2002)	51
3.2.3 Testing of the antimicrobial efficacy of a bacterial cellulose wound dressing containing polihexanide in an <i>in vitro</i> model for wound infection	54
3.3 Binding of inflammatory mediators (active wound dressings)	58
3.3.1 Binding capacity of a composite material of bacterial cellulose and collagen for inflammatory mediators <i>in vitro</i>	58
3.3.2 Influence of the collagen origin on the binding affinity for proteases, cytokines, and growth factors	60
3.3.3 Effect of sterilization procedures on the performance of bovine collagen type I on chronic wound parameters <i>in vitro</i>	65

3.3.4 Binding capacity of alginate and silver-containing alginate for pathophysiological factors in chronic wounds	71
3.3.5 Comparison of biopolymer-based biomaterials regarding binding capacity for elastase and antioxidative potential <i>in vitro</i>	75
4. Summary	77
5. Zusammenfassung	81
6. References	85
7. Appendix	93
7.1 Abbreviation list	93
7.2 Figure index	95
7.3 Declaration of authors' contribution	99
7.4 Original published work	101
7.5 Acknowledgments - Danksagung	198
7.6 Curriculum vitae	199
7.7 Ehrenwörtliche Erklärung	200