

CONTENTS

1. Introduction.....	1
1.1 Introduction to packaging.....	1
1.2 Biodegradable polymers.....	3
1.3 Nanotechnology to reinforce bioplastics.....	7
1.3.1. Nanoclays.....	7
1.3.2 Cellulosic nanomaterials.....	10
1.3.3 Carbon based nanomaterials.....	12
1.4 Properties of interest in biopackaging applications.....	13
1.4.1 Barrier properties.....	13
1.4.1.1 Introduction to mass transport properties.....	13
1.4.1.2 Modeling mass transfer process.....	14
1.4.1.3 Measuring mass transport properties.....	19
1.4.1.4 Factors influencing mass transport properties...	22
1.4.1.5 Barrier properties in nanobiocomposites for monolayer packaging: PLA, PCL, PHA and starch.....	31
1.4.2 Thermal properties.....	35
1.4.3 Mechanical properties.....	36
1.5 References.....	40
2. Objectives.....	48
3. Results.....	49

Chapter I. Nanobiocomposites based on nanoclays.....50

Paper I: M.D. Sanchez-Garcia, E. Gimenez and J.M. Lagaron Development and Characterization of Novel Nanobiocomposites of Bacterial Poly(3-hydroxybutirate), Layered silicates and Poly(ϵ -caprolactone). Journal of Applied Polymer Science, 2008; 108, 2787–2801
.....50

Paper II: M.D. Sanchez-Garcia, E. Gimenez and J.M. Lagaron. Comparative Barrier Performance of Novel PET Nanocomposites With Biopolyester Nanocomposites of Interest in Packaging Food

Applications. Journal of Plastic Film and Sheeting 2007; 23 133-148.....83

Paper III: M.D. Sanchez-Garcia and J.M. Lagaron. Novel clay based nanobiocomposites of biopolyesters with synergistic barrier to UV light. Journal of Applied Polymer Science 2010; 118, 1, 188-199.....99

Paper IV : M.D. Sanchez-Garcia, L. Hilliou and J.M. Lagaron. Nanobiocomposites of Carrageenan, Zein and Mica of Interest in Food Packaging and Coating Applications. Journal of Agricultural and Food and Chemistry 2010; 58 11, 6884-6894.....125

Paper V: M.D. Sanchez-Garcia, E. Gimenez, M.J. Ocio and J.M. Lagaron. Novel Polycaprolactone nanocomposites containing thymol of interest in antimicrobial film and coating applications. Journal of Plastic Film and Sheeting 2008; 24, 239-251.....154

Chapter II. Nanobiocomposites based on micro and nano cellulose fibers.....170

Paper VI: M.D. Sanchez-Garcia, E. Gimenez and J.M. Lagaron. Morphology and Barrier Properties of Solvent Cast Composites of Thermoplastic Biopolymers and Purified Cellulose Fibers. Carbohydrate Polymers 2008; 71, 235-244.....171

Paper VII: M.D. Sanchez-Garcia and J.M. Lagaron. On the use of plant cellulose nanowhiskers to enhance the barrier properties of polylactic acid. Cellulose 2010; 17, 987-1004.....195

Paper VIII : M.D. Sanchez-Garcia, L. Hilliou and J.M. Lagaron. Morphology and Barrier Properties of Solvent Cast Nanobiocomposites of κ /t--carrageenan and Cellulose Nanowhiskers. Journal of Agricultural and Food and Chemistry 2010; 58, 12847-12857.....232

Chapter III. Nanobiocomposites based on Carbon nanotubes and Carbon Nanofibers.....259

Paper IX : M.D. Sanchez-Garcia, J.M. Lagaron, S.V. Hoa. Effect of addition of carbon nanofibers and carbon nanotubes on properties of thermoplastic biopolymers. Composites Science and Technology 2010; 70, 1095-1105.....260

Chapter IV. Blends of biobased materials.....286

Paper X: D. Nordqvist, M. Dolores Sanchez, M.S. Hedenqvist and Jose M. Lagaron. Incorporating amylopectin in poly(lactic acid) by melt blending using poly(ethylene-co-vinyl alcohol) as a thermoplastic carrier. (i) Morphological characterization. Journal of Applied Polymer Science 2009; 115, 3, 1315 – 1324.....287

Paper XI: M.D. Sanchez-Garcia, D. Nordqvist, M.S. Hedenqvist and Jose M. Lagaron. Incorporating amylopectin in poly(lactic acid) by melt blending using poly(ethylene-co-vinyl alcohol) as a thermoplastic carrier. (ii) physical properties. Journal of Applied Polymer Science 2011; 119, 3708-3716.....307

4. Conclusions.....325

5. Annex.....331