CHITOSAN INTELLIGENT FILMS: RELATIVE HUMIDITY INDICATOR

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A new and biodegradable intelligent film was developed. Relative humidity (rh) indicator was incorporated into chitosan matrix films. Chitosan is the second biopolymer naturally present on the planet, which is discarded at tons by the fishing industry. This polymer presents great ability to form films. The future of petrol resources and the difficult on waste disposal are factors that is becoming interesting study new biodegradable and renewable sources materials for packages. A colorimetric relative humidity indicator (1.0%, w/w) was incorporated into chitosan matrix films (2.0%, w/w). These films could be applied as external packaging to control the environmental during transportation and storage.

Properties

Homogeneous, thin, flexible and transparent films were obtained. The water barrier properties (WVTR), water solubility, mechanical properties (ε_r- elongation at break, E- Young Modulus and Tr – tensile at break) (Table 1) and microstructure (SEM images) were measured.

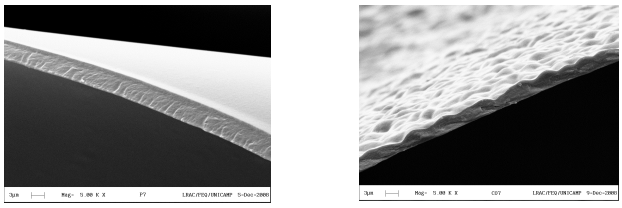
Table 1. Properties of chitosan and chitosan-intelligent films.

Properties	*Chitosan film*	*Chitosan-intelligent film*
WVTR (10^{-3}g/mdiakPa)	1.07±0,048[a]	1.66±0,05[b]
Water solubility (%)	100.00±0,00[a]	3.34±1,25[b]
Moisture content (%)	8.79 ± 0,88[a]	5.38 ± 0,25[b]
Thickness (μm)	32.0 ± 3,0[a]	43.0 ± 2.0[b]
ε_r (%)	3.89±0,46[a]	2.05±0,25[b]
E (GPa)	2.40±0,17[a]	2.30±0,22[a]
Tr (MPa)	49.98±2,51[a]	47.07±4,78[a]

[a-b] Means in the same line with different superscripts differ significantly (p≤0.05) according to Tukey test.

The indicator presence increased the WVTR of chitosan films. Morphological differences were evident in microphotographs of cross-sections of chitosan films (Figure 1). It was possible to see that chitosan film formed a homogeneous and cohesive matrix, indicating a smooth surface without pores or cracks. Conversely, chitosan intelligent films showed a more amorphous structure, suggesting the presence of pores and void spaces in the film matrix. This structure could facilitate the movement of water vapour molecules, leading to higher WVTR values than in chitosan film. Interstitial voids formed by the distribution of indicator dispersed phase droplets in the polymer matrix could facilitate moisture diffusion.[1,2]

The ε_r of chitosan intelligent films were poorer than those of chitosan film. The indicator presence have reduced the flexibility due to their stiffer matrix structures



(a) **(b)**

Figure 1. Cross-section of (a) chitosan film and (b) chitosan intelligent film.

Colour response

The colorimetric indication of relative humidity variations was determined by L*, a*, b* colour parameters using a colorimeter (Konica Minolta, Japan). The final colour response was evaluated submitting chitosan intelligent films in a range of relative humidity of 0-95%. The colour of chitosan films changed the pink to blue, in low and high relative humidity conditions, respectively.

ACKNOWLEDGEMENTS

FAPESP, CAPES, CNPq., Suzano Papéis e Celulose Ltda.

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