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Mango Puree Edible Films Reinforced with Cellulose Nanofibers

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Abstract – Mango puree edible films have been reinforced by adding different concentrations of cellulose nanofibers (CNF), whose effect was studied in terms of tensile properties, water vapor permeability (WVP) and glass transition temperature (T_g) of the films. CNF were effective in increasing tensile strength and modulus, especially at higher concentrations, suggesting the formation of a fibrillar network within the matrix. The addition of CNF was also effective to decrease WVP of the films. Its influence on T_g was small but significant. The study demonstrated that the properties of mango puree edible films can be significantly improved through CNF reinforcement.

This study was conducted to evaluate effects of cellulose nanofibers (CNF) on tensile properties and water vapor permeability (WVP) of mango puree edible films (MPEF). CNF were added to the mango puree, dispersions were homogenized, vacuum-degassed, cast on glass plates and allowed to dry. Tensile properties were measured by using an Instron 55R4502. The gravimetric Modified Cup Method [1] was used to determine WVP.

Table 1 presents physical properties of MPEF. CNF were effective in increasing tensile strength (TS) and Young's modulus (YM). Elongation at break (EB) was only decreased at higher CNF concentrations (>10%). According to Figure 1, both TS and YM were improved when compared to those of the neat mango puree matrix. The effect of CNF on EB depended on CNF loading - 10% did not affect EB, but 36% impaired it, suggesting poor interactions between CNF and the matrix at such high CNF loading. CNF were effective to decrease WVP of films, probably because they increase the matrix tortuosity, delaying diffusion [2].

Table 1: Properties of MPEF with different CNF loadings. Means with same letter do not differ ($p<0.05$).

CNF (%)	TS (MPa)	EB (%)	YM (MPa)	WVP (g.mm/ kPa.h.m^2)
0	4.09^{e}	44.07^{a}	19.85^{e}	2.66^{a}
1	4.24^{de}	42.42^{ab}	21.55^{e}	2.40^{ab}
2	4.42^{de}	43.30^{ab}	22.56^{e}	2.17^{bc}
5	4.58^{cd}	41.79^{b}	30.93^{d}	2.16^{bc}
10	4.91^{c}	43.19^{ab}	40.88^{c}	2.03^{c}
18	5.54^{b}	39.80^{b}	78.82^{b}	1.90^{cd}
36	8.76^{a}	31.54^{c}	322.05^{a}	1.67^{d}

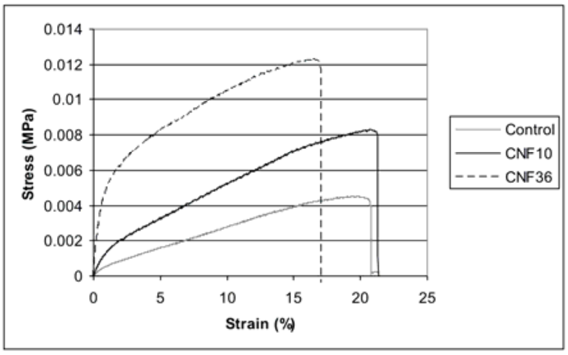

Figure 1: Stress-strain curves for MPEF with CNF loadings of 0% (control), 10% (CNF10), 36% (CNF 36).

[1] T.H. McHugh, R.J. Avena-Bustillos, and J.M. Krochta. J Food Sci 58(1993):899–903.
[2] M.D. Sanchez-Garcia, E. Gimenez, and J. M. Lagaron. Carbohydr Polym 71 (2008):235-244.

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