Influence of high pressure on the viscoelastic properties of native glucomannan gels after frozen storage

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Objective: To analyse the effect of high hydrostatic pressure (HHP=200 MPa), on the viscoelastic properties of glucomannan (GM) gels at 5 g/100mL GM concentration, after two years of frozen storage at -20 °C.

Material and Methods

Glucomannan (GM) gels

Konjac glucomannan (KGM): neutral hydrocolloid from Amorphophallus konjac C. Koch

Ideal fraction network provides a measurement of the level of reticular order in the gel network [1]. In control gel, frozen storage slightly increased the ability of network to store energy increasing the time stability as evidenced in the decrease of power-law exponent (Fig. 2a). In pressurized gel (Fig. 2b) the structural stabilization was increased, and consequently the level of the reticular organization in GM matrix after frozen storage was enhanced (FN200 vs N200).

Samples

native 5% GM gels (pH=5.3): control gel (N), pressurized native gel at 200 MPa (N200).

Dynamic tests

- **Stress sweeps:** $\nu = 1 \text{ Hz}; T = 25 ^\circ \text{C}; \sigma_{\text{final}} = 100 \%$; $\sigma_{\text{initial}}=1 \text{ Pa}; \sigma_{\text{final}}=1,500 \text{ Pa}$.
- **Frequency sweeps:** $\nu = 0.01-10 \text{ Hz}$; $T = 25 ^\circ \text{C}; y = 1 \%$.
- **Temperature sweeps:** $\Delta T = 25-90 ^\circ \text{C}; v=1 ^\circ \text{C/min}; v=0.1 \text{ Hz}; y=1 \%$.

**Results and Discussion**

Structural damage (decrease of stress and strain amplitudes) associated to frozen storage was something reduced in pressurized gels (Fig. 1a- b). The gel strength expressed in terms of complex modulus ($G^\prime$) maintained similar values after frozen storage irrespective of pressure treatment (Fig. 1c).

Frozen storage maintained the same thermo-rheological response than in fresh materials. Therefore, for N and FN gels $G^\prime$ was slightly temperature-dependent, and for pressurized GM gels the rubber-like [2] at T>70 °C as evidenced in the decrease of phase angle with T, more strongly for N200 (Fig. 3b). After frozen storage this new gelling process at high T was stopped.

Conclusions: 5% GM gels after two years stored at -20 °C kept the principal rheological properties and thermal responses comparing with fresh samples. Some structural benefits produced by HHP were even enhanced.

**References**