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

INSTITUTE OF FOOD SCIENCE, TECHNOLOGY AND NUTRITION

C.A. Tovar[1], L. Piñeiro[1], A.J. Borderías[2], B. Herranz[2]

1 Department of Applied Physics, Faculty of Science of Ourense. University of Vigo, (Spain).
2 Department of Products, Institute of Food Science, Technology and Nutrition (ICTAN-CSIC), (Spain).

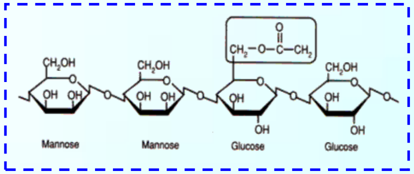
University of Vigo

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**



Samples

- native 5% GM gels (pH=5.3): control gel (N), pressurized native gel at 200 MPa (N200).
- native 5% GM gels after 2 years at -20 °C: frozen- native gel (FN); frozen-pressurized gel (FN200).

Dynamic tests

- ***Stress sweeps:*** ν = 1 Hz; T= 25 °C; γ_{final}= 100 %; $\sigma_{initial}$=1 Pa; σ_{final}=1,500 Pa.
- ***Frequency sweeps:*** ν =0.01-10 Hz; T= 25 °C; γ = 1 %.
- ***Temperatrue sweeps:*** ΔT= 25-90 °C; v= 1 °C/min; ν = 0.1 Hz; γ = 1 %.

BOHLIN- CVO Rheometer

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**) maintained similar values after frozen storage irrespective of pressure treatment (Fig. 1c).

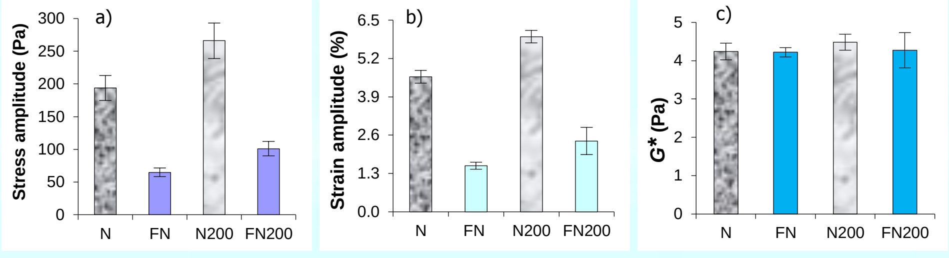


Figure 1.- Influence of HHP=200 MPa on the linear viscoelastic (LVE) parameters: stress amplitude (a); strain amplitude (b); complex modulus (*G**) (c), after frozen storage of 5% GM gels, T=25 °C.

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).

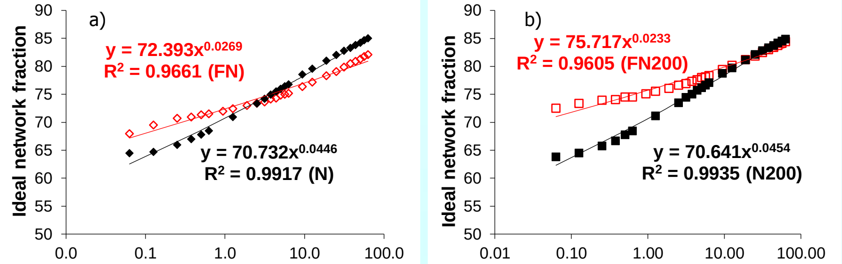


Figure 2.- Effect of frozen storage on mechanical spectra in terms of the ideal fraction network, of native (a) and pressurized (b) GM gels at 5% concentration, T=25 °C.

Frozen storage maintained the same thermo-rheological response than in fresh materials. Therefore, for N and FN gels *G´* was slightly temperature-dependent, and for pressurized GM gels the rubber-like [2] at T> 70 °C was preserved in FN200 comparing with N200 (Fig. 3a).

Temperature sweeps produced a second gelation process in both N and N200 gels reinforcing the gel characteristics 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.

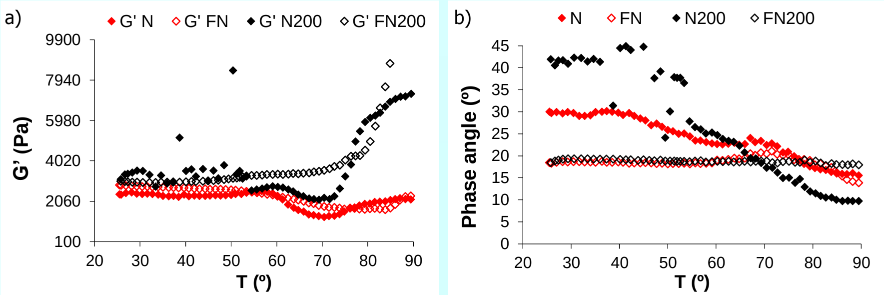


Figure 3.- Influence of frozen storage on thermal gelation profiles of native and pressurized of 5% GM gels, T=25 °C. Storage modulus (*G´*) (a); phase angle (b).

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.

Ref.

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2. Lee, H.G., Lanier, T.C. and Hamann, D.D. (1997). Journal of Food Science, 62, 25-28.