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J Food Process Technol 2018, Volume 9
DOI: 10.4172/2157-7110-C1-078

21st Euro-Global Summit on

Food and Beverages

March 08-10, 2018 | Berlin, Germany

On the interpretation of textural properties of gels through the mechanics of soft materials

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Textural parameters determined in Texture Profile Analysis (TPA) depend on test settings such as loading speed and deformation level. The aim of this work is to interpret the differences observed in TPA as a function of these variables, through the determination of intrinsic mechanical parameters. Gelatin gels (20% w/w) are used as a model system due to their simplicity and well known structure. Stress-strain behavior at various loading speeds and deformation levels was studied by macroindentation and uniaxial compression experiments. The stress and strain at break values (σB, εB) and the Ogden constitutive parameters (μ, shear modulus and α, strain hardening capability) were obtained. Fracture toughness values (Gc) at different loading rates were determined by the wire cutting method. Textural parameters were obtained from TPA carried out at different loading speed and strain level. Increasing loading speed from 5 to 100 mm/min does not modify the stress-strain response but shift σB and εB to higher values, i.e. gels survive higher compression strains. This effect is also evidenced in the Gc values, which is duplicated in the loading rate range. The increment in the deformation level from 30 to 80% mainly affects α parameter and indicates that strain hardening is not evidenced at small deformation levels. The loading speed dependence of TPA parameters is clearly evidenced in cohesiveness, related with gel integrity. The gels support higher maximum deformation levels without changes in cohesiveness when strain rate is increased. On the other hand, hardness increases with the strain level, which is explained by the strain hardening phenomenon manifested at high deformation. This results show that the effects of the TPA configuration on the measured textural properties can be understood in terms of mechanical behavior and intrinsic mechanical parameters. Thus, tests coming from soft materials science may contribute to the knowledge of the structure-texture relationship.

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