Rheological behaviour of fruit and milk-based smoothies

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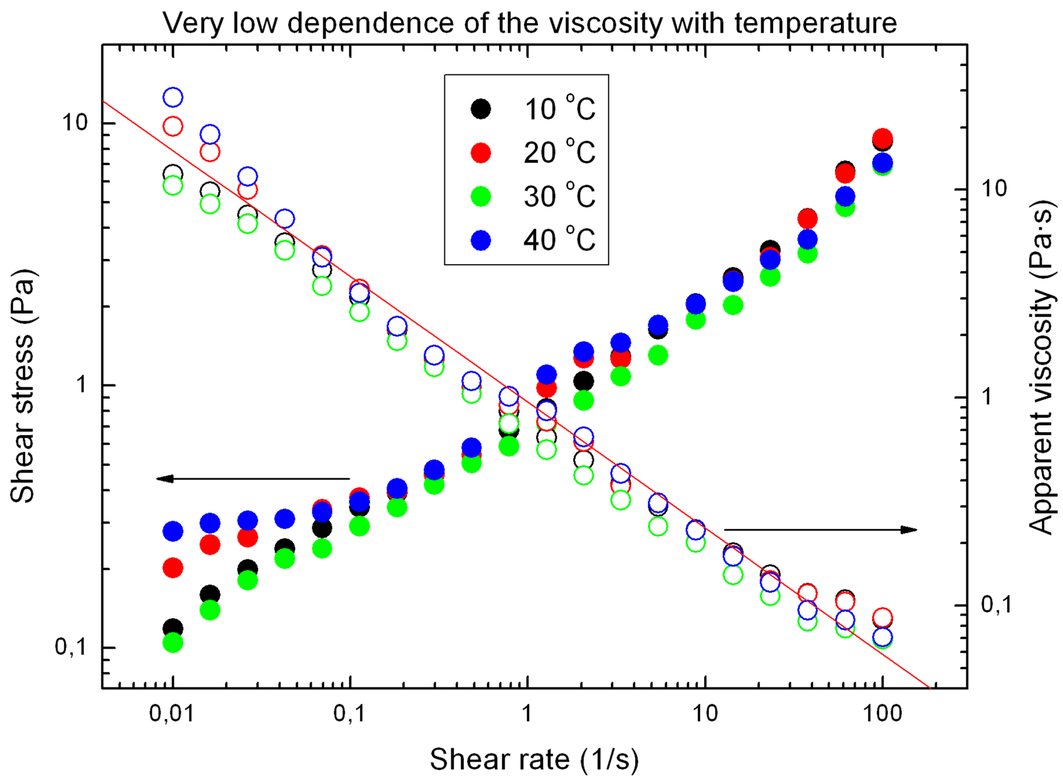
Background

- Two of the most important food attributes for today´s fast-moving lifestyle are convenience and healthiness [1-2]. Fast-moving lifestyle specifically affects to elderly people, who are prone to bad-nutrition due to their dental status reducing the consumption of fruits and vegetables [3].
- Smoothies are blended beverages, and good examples of convenient and healthy foods for helping to reduce this problem. So, they are gaining increasing market leverage in the beverage sector.
- Texture and rheological behaviour of foods can determine their acceptability. Therefore, added to nutritious features, smoothies must also account with outstanding mechanical properties. Stability of the products is also a main quality, which can be gained adding a small amount of stabiliser to beverage formulations. But, to avoid opposite effects, stabilisers addition should ameliorate the product texture.

Experimental

- Materials: bananas (BB), apples (AA), and pears (PP) (purchased in a local market). Lactose-free cow milk (LL) (COVAP, Córdoba, Spain). Xanthan gum (XX) (Sigma-Aldrich).
- Stress controlled rheometer: Haake MARS (Thermo Scientific, Germany). Cone-plate (35mm, 1º).
- Methods: Samples stored at 4ºC during 3h prior to measurement. Pre-shear of 50s^{-1} during 60s and rest during 120s. Temperature control with a Peltier system.
- Nomenclature: BBAAPPLLXX in %w/w

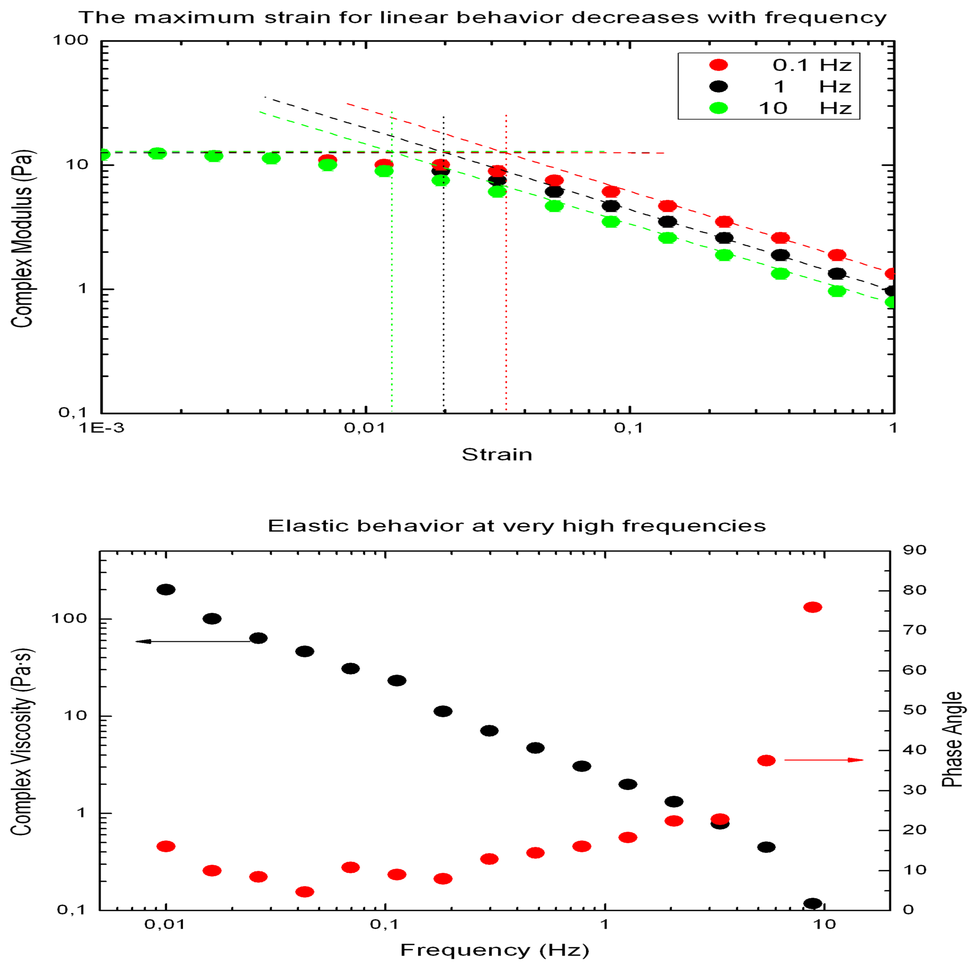
Steady Flow. SFC



- SFC of the smoothy composed by 14%w/w banana, 14%w/w apple, 14%w/w pear and 58%w/w milk at different temperatures. Error bars (lower than 5%) are omitted for clarity. Power law model was fitted (only fitting corresponding to 20ºC is shown for clarity).

Smoothy	K (Pa·s^n)	n	r^2
1414145800	0.95±0.05	0.39±0.02	0.987
1313136100	0.90±0.06	0.42±0.04	0.979
1212126400	0.85±0.04	0.45±0.03	0.992
1414145801	1.54±0.03	0.39±0.04	0.977
1313136101	1.40±0.07	0.43±0.03	0.984
1212126401	1.33±0.05	0.45±0.02	0.982

Dynamical Analysis. SAOS



- SAOS analysis of the smoothy composed by 14%w/w banana, 14%w/w apple, 14%w/w pear and 58%w/w milk at 20ºC.

Smoothy	f_{critic} (Hz)
1414145800	7.2±0.5
1313136100	8.5±0.3
1212126400	9.7±0.4
1414145801	7.8±0.4
1313136101	8.9±0.5
1212126401	10.5±0.5

Highlights

- Very low influence of temperature on the viscosity was observed in all smoothies.
- Slope and intercept increase with the amount of fruit (see table).
- Slope does not vary but intercept increases with the presence of xanthan gum (see table).
- Elastic behavior dominates only at high frequencies .
- The critic frequency for the transition from viscous to elastic behavior decreases with the amount of fruit (see table).
- The critic frequency for the transition from viscous to elastic behavior increases with the presence of xanthan gum (see table).

References

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