

Acoustic Properties of Chihuahua, Manchego, and Panela type Cheeses, Applying Ultrasonic Spectroscopy

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ABSTRACT

In Mexico, there is a wide variety of cheeses which are produced according to their región of origin. From which, most are made from cow's milk, and in some cases from goat's or sheep's milk, depending on its type. In this Research, a study to determine the acoustic properties of Chihuahua, manchego, and panela cheeses, applying acoustic spectroscopy in the ultrasound spectrum. The echoscope block of the GAMPT® acoustic tomograph with acoustic sensors at 2MHz was used to measure the acoustic phase velocity depending on the thickness, with a quasi-regular temperature 16°C of the environment. The method applied was by transmission with normal incidence. The volumetric density and acoustic impedance of the cheeses as well as the rheological properties were determined by indirect method. The results show that the acoustic phase velocity of the Chihuahua, manchego, and panela cheeses were $APV_{Chi} \approx 1121.47\text{m/s}$, $APV_{man} \approx 1436.05\text{m/s}$ y $APV_{pan} \approx 1142.28\text{m/s}$, respectively. The volumetric density of the Chihuahua, manchego, and panela cheeses were $\rho_{Chi} \approx 1.16\text{gr/cm}^3$, $\rho_{man} \approx 1.11\text{gr/cm}^3$ y $\rho_{pan} \approx 1.70\text{gr/cm}^3$ a 12.1°C, respectively. In addition, the acoustic transmittance was explored, where a great attenuation was presented in all the products. It is possible that at a frequency of 2MHz the propagation of the wave through the cheese samples is attenuated as a sum of the absorption and scattering of the wave itself within the cheese structure. There is interest in continuing to explore and characterize the acoustic properties of milk derivatives such as, cream, yogurt, etc. As well as the benefits offered by the measuring instrument.



INTRODUCTION

LOW INTENSITY ULTRASOUND

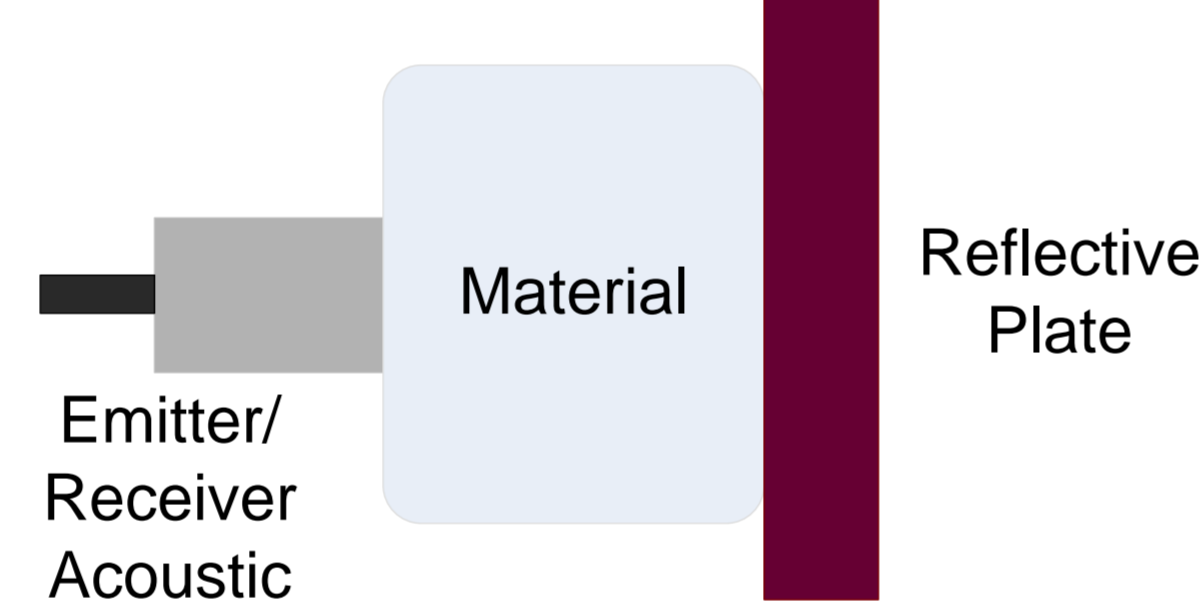
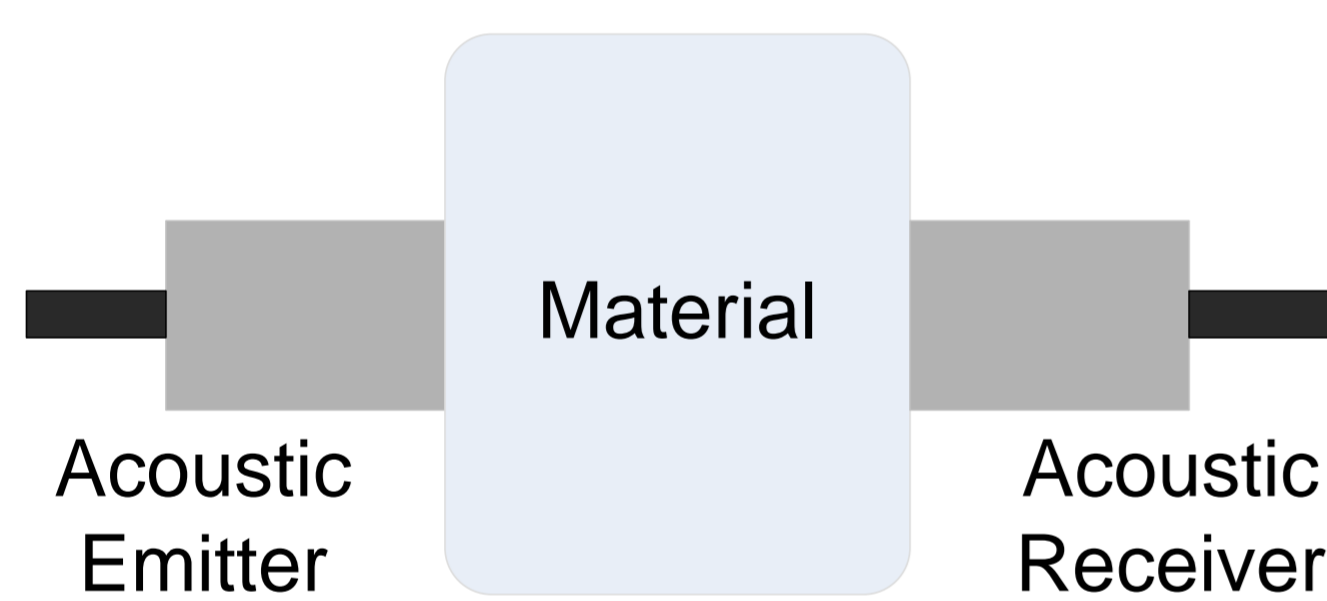


Name	Range, (Hz)
Infrasound	IS < 16
Audible Sound	16 ≤ AS ≤ 17.8
Ultrasound	17.8 < US < 1 G
Hypersound	HS ≥ 1 G

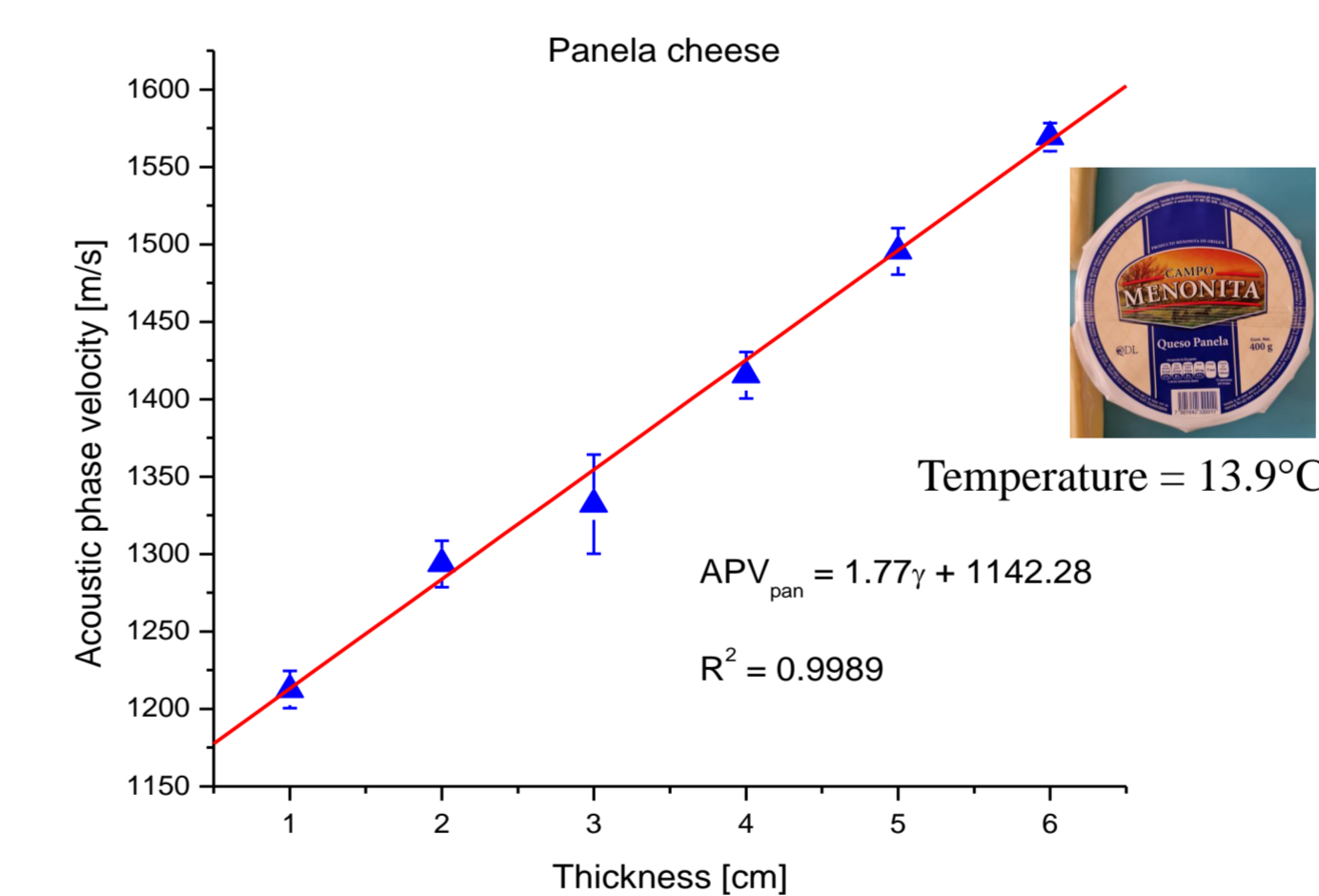
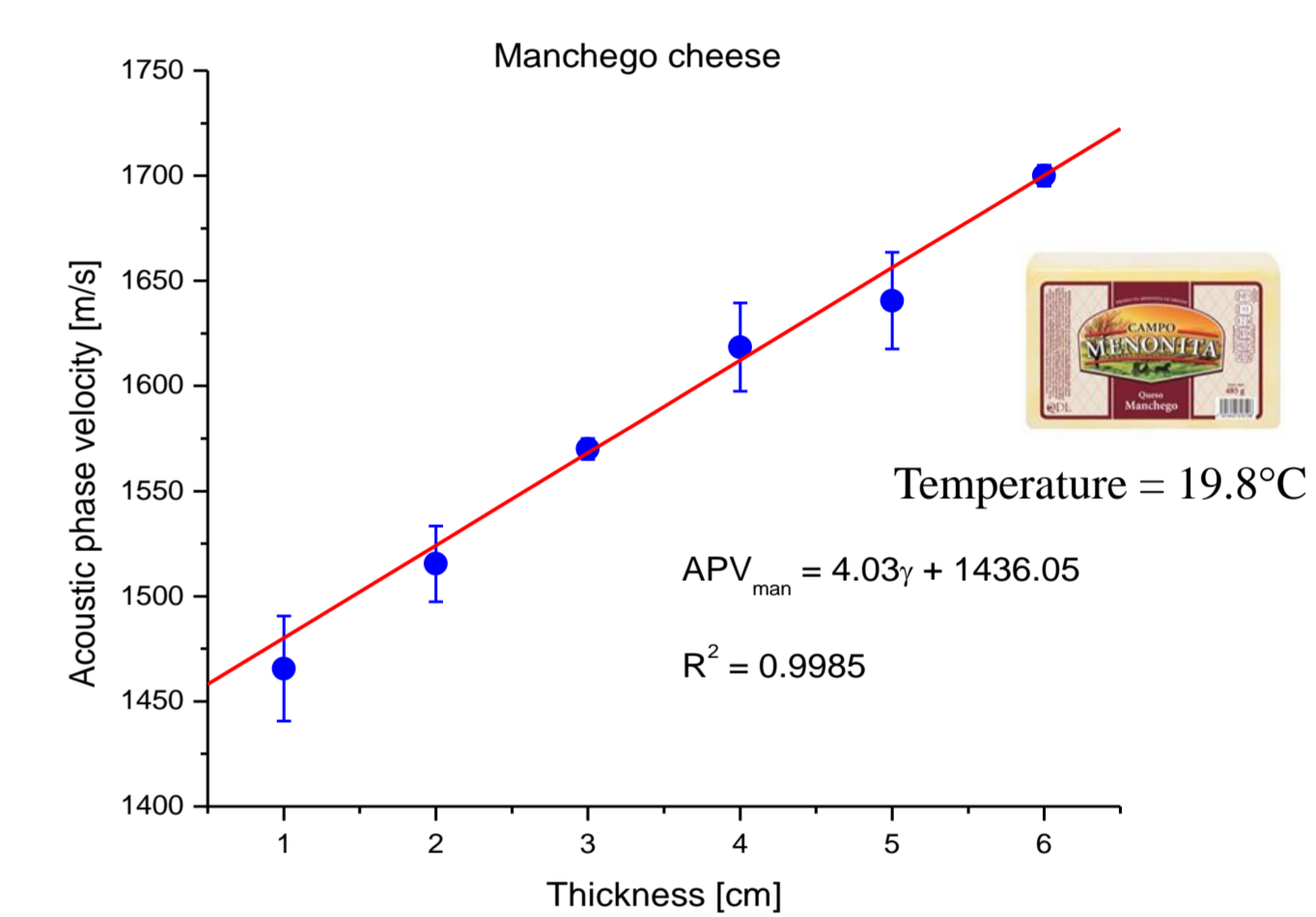
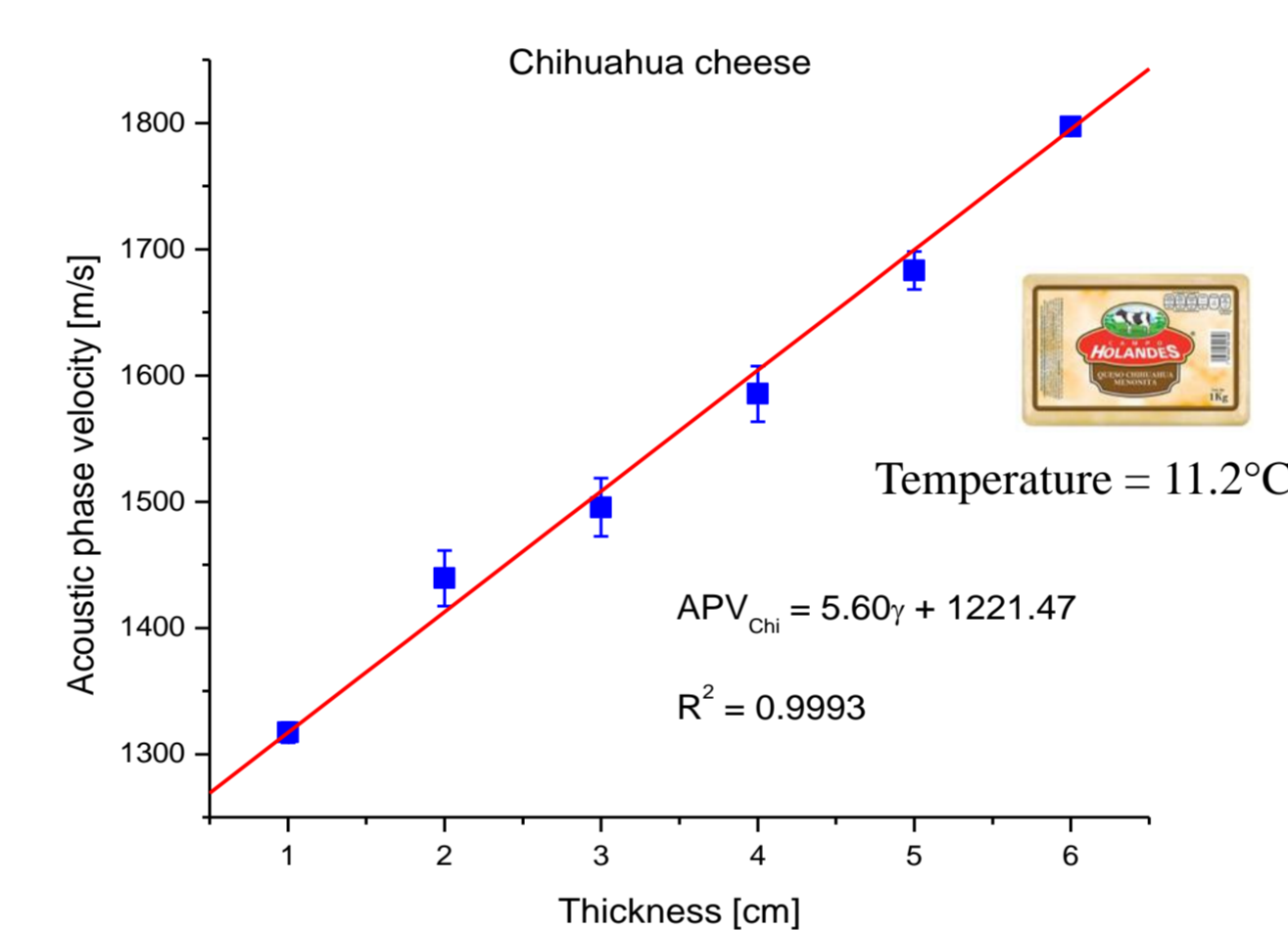
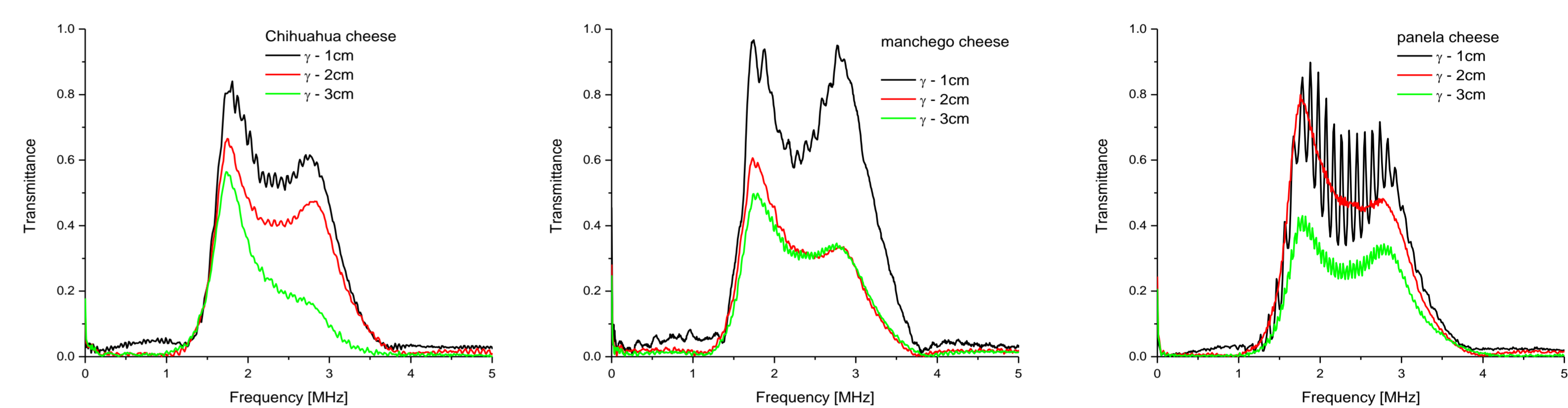


TRANSMISSION METHOD

PULSE – ECHO METHOD



RESULTS



PARAMETER	Chihuahua	manchego	panela
Acoustic phase velocity, transmission method [m/s]	1221.47 ± 1.53	1436.05 ± 0.66	1142.28 ± 0.66
Bulk density, ρ [gr/cm³]	1.16 ± 0.05	1.11 ± 0.05	1.70 ± 0.05
Acoustic impedance, Z [MRayls]	5.706	2.337	7.893
Elastic modulus, G [Pa]	5.706	2.337	7.893
Loss modulus by viscoelasticity, G'' [Pa]	367261.55	273908.9	1242795.77
Acoustic attenuation, α [dB/cm]	0.2728	0.3570	0.7582

MATERIALS



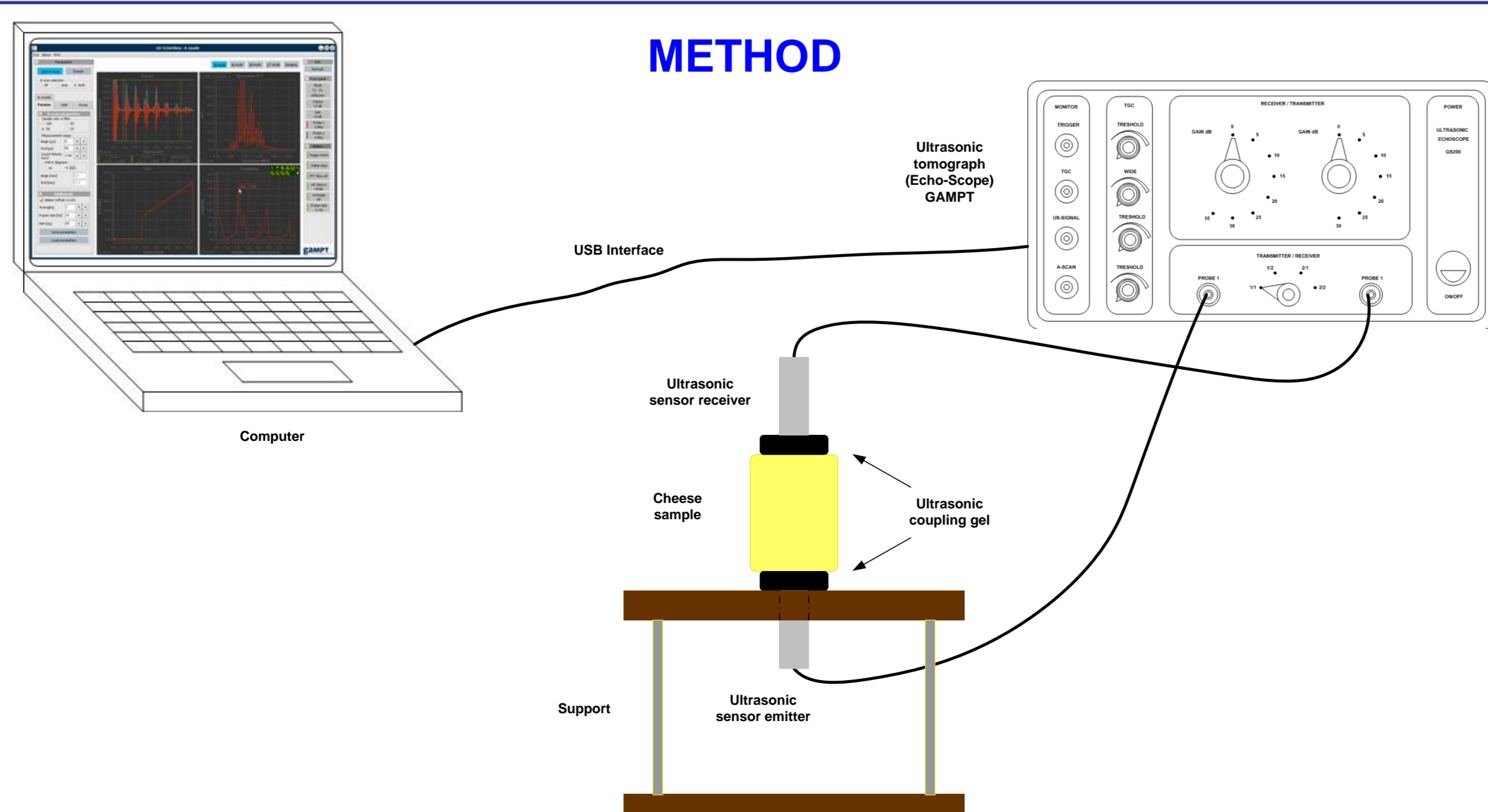
- Experimental conditions:**
- ✓ 7 – 10 AM.
 - ✓ Cheese samples type: Chihuahua, panela, and manchego.
 - ✓ Sampling rate: 100MHz.
 - ✓ Excitation pulse: normal incidence.

Thermodynamic conditions:

- ✓ Open system.
- ✓ Atmospheric pressure: 1020.1hPa
- ✓ Humidity: 30%
- ✓ Laboratory temperature: 16±1°C



METHOD



CONCLUSIONS

- ✓ The acoustic properties of commercial cheeses such as Chihuahua, manchego, and panela were characterized.
- ✓ Until now, the acoustic properties of the cheeses studied were not found in the reported literature. There are results of the other types of cheeses.
- ✓ Using acoustic pulses as excitation sources generates a greater scattering in the intrinsic properties of cheeses.
- ✓ It is possible to increase the sensitivity capacity of the experiments, if it is done by means of an adiabatic system.
- ✓ It is proposed to produce Chihuahua, manchego, panela and other cheeses, to characterize their acoustic and mechanical properties, and compare their results with the properties of commercial cheeses.

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