Surface Properties of Aqueous Solutions of Biocompatible Saponins-based Biosurfactants mixtures

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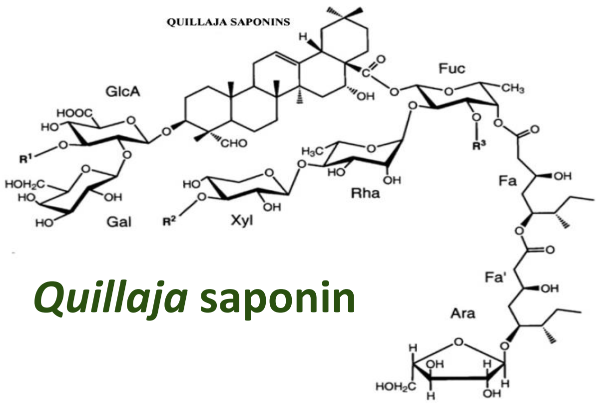
MOTIVATION

Saponins are frequently encountered in nature biosurfactants with specific chemical structure and various biological activity (they exhibit anti-allergic, anti-inflammatory, antiviral, antibacterial activity, reduce the cholesterol and fatty acids absorption and are used as adjuvants in vaccines preparation, etc.). Biocompatible foams, stabilized by saponins and their mixtures with other bioactive substances are widely applied in different processes in food, cosmetics, pharmaceutical industry and medicine. Obtaining information about the behavior of such systems, as well as the ability to control their properties, are important for their specific use. The investigation of real disperse systems, such as foams is a complicated matter, but they can be characterized by model systems. Thin foam films – one of the basic elements of foams, are an appropriate model for studying the stability of disperse systems and an instrument for investigating the properties of surface-active compounds at two approaching interfaces.

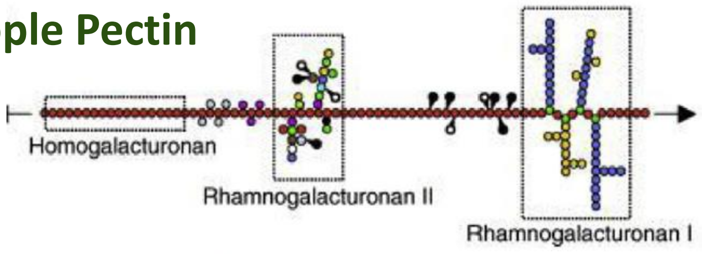
MATERIALS:



***Quillaja* saponin**

Quillaja saponin is a bidesmosidic triterpenoid saponin. The molecule consists of a triterpenoid backbone (named aglycone) to which two sugar chains are attached – one connected with an ether bridge at position C3, the other sugar chain is connected with an ester bridge at position C28. The amphiphilic structure defines the saponin's ability to adsorb at the air/ water interface. The saponin is an extract from the *Quillaja Saponaria* tree and exhibits various biological activities.

Apple Pectin



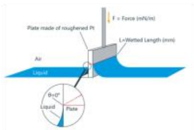
Natural polysaccharide, whose molecule consists predomintally of galacturonic acid. Used as a foams and emulsions stabilizer in different industrial processes

EXPERIMENTAL RESULTS

I. Equilibrium surface tension

FORCE TENSIOMETER KRÜSS K20

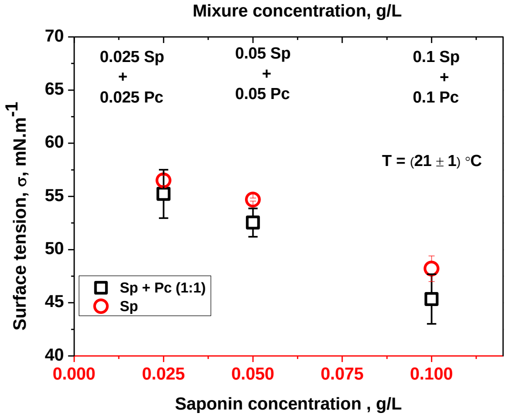
The surface tension measurements are based on the Wilhelmy plate method



$$\sigma = \frac{F}{L \cdot \cos\theta}$$

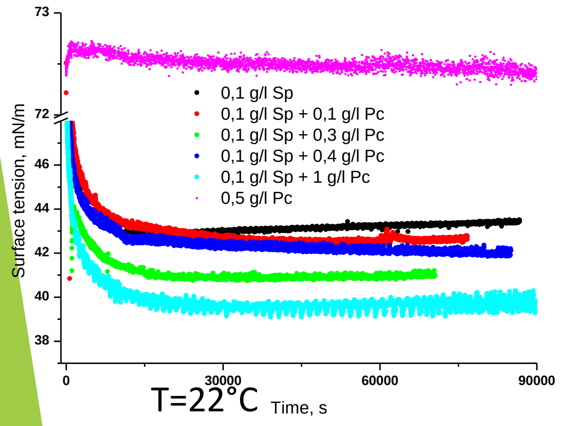
σ – surface tension, F- force with which the water pulls the plate, L - perimeter of the contact line of the plate with the liquid, θ –wetting angle.

The apparatus gives the opportunity of obtaining the equilibrium surface tension of the investigated solutions as well as following the change of surface tension with time.



Surface tension values of mixed solutions are lower then those of the pure *Quillaja Saponin* solutions.

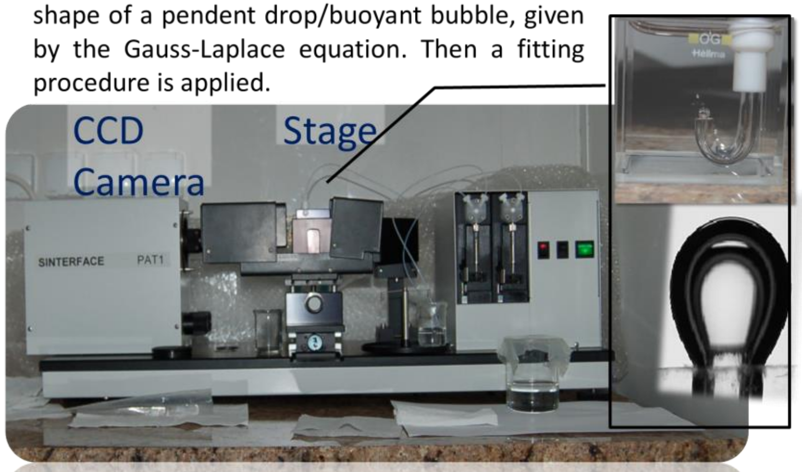
II. Dynamic surface tension and surface rheology of the adsorption layers at air/water interface.



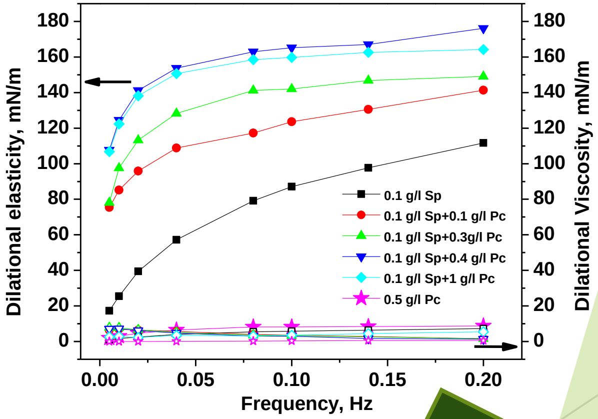
The surface tension decreases with the increase of the Pectin concentration. A synergetic effect of both biosurfactants in the mixed solutions is observed.

PROFILE ANALYSIS TENSIOMETER

The surface tension is determined from the shape of a pendent drop/buoyant bubble, given by the Gauss-Laplace equation. Then a fitting procedure is applied.

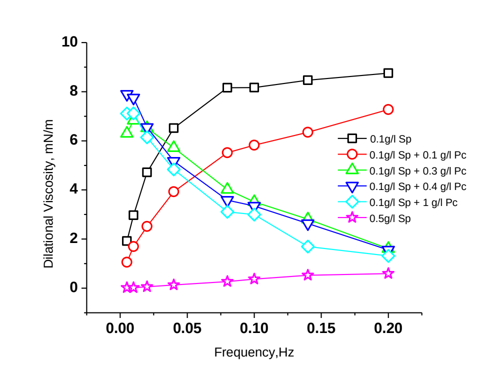


Bubble mode with a specialy designed glass capillary is applied.



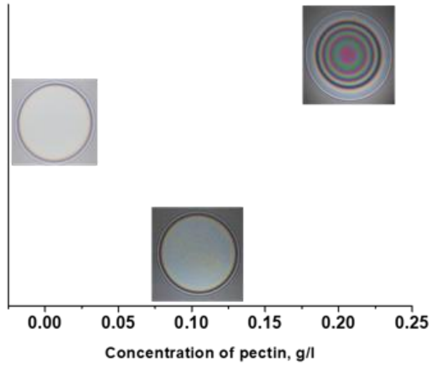
- A maximum of the surface dilatational elasticity at C (Pc) =0.4 g/l is observed.
- At higher frequencies (ν > 0.10 Hz) the dilatational elasticity remains practically unchanged.

The surface dilational viscosity decreases with the increase in the Pectin concentration but this change is weakly expressed.



EXPERIMENTAL RESULTS

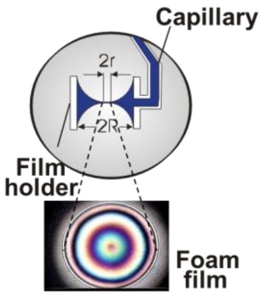
III. Thin liquid films properties (kinetics of drainage, disjoining pressure vs. film thickness isotherms, stability)



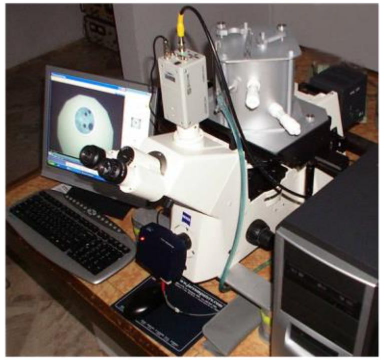
The increase of the Pectin concentration (at constant Saponin concentration: C (Sp) = 0.1 g/l) leads to the formation of films with inhomogeneous thickness.

THIN LIQUID FILMS APPARATUS

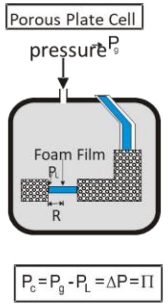
Measuring cell with a glass film holder



Enables film investigation under constant capillary pressure

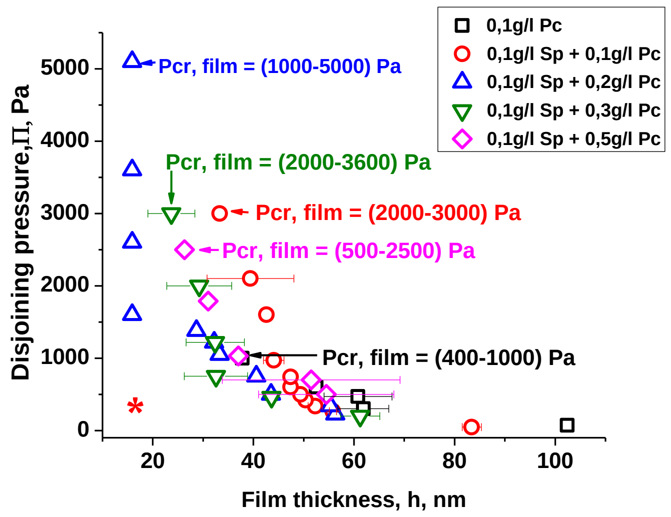


Thin Liquid Film Pressure Balance Technique



Enables a direct measurement of disjoining pressure (Π) vs. film thickness (h) isotherms and allows following up film behavior in a large pressure range.

Films obtained from mix solutions are significantly more stable than those from single Saponin or Pectin solutions. A maximum P cr, film is observed for Pectin concentration C (Pc)=0.2 g/l.



*at C = 0.1 g/l Saponin films are unstable, they rupture at the moment of their formation and Π (h) – isotherms cannot be obtained.

CONCLUSION:

- **The investigated systems form a mixed adsorption layer at air /solution interface;**
- **Complex mixed structures, containing both biosurfactants are formed in the bulk solutions;**

The obtained information is essential for optimizing the composition and predicting the properties of biocompatible foams based on *Quillaja* saponins and its mixtures with Apple Pectin in view of their future industrial, pharmaceutical and biomedical applications.

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