Saponins –natural surfactants with unique properties and functionality

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Saponins are molecules, found in over 500 plant species [1-3] in various parts of the plant like roots, leafs, bark, seeds, stems, etc. The saponin content in some (parts of) plants can reach up to 10-20 % of dry matter, which makes natural source extraction potentially commercially feasible and sustainable. Saponins are surfactants as the saponin molecule contains a hydrophobic part, composed of a triterpenoid skeleton, and a hydrophilic part consisting of one or more (rarely more than two) oligosaccharide chains, attached to the hydrophobic scaffold (aglycone).

From a purely scientific point of view saponins are unique and differ from classical surfactants, which normally have hydrophilic head group and hydrophobic tail. Saponins on the contrary can be considered as inverted (gemini) surfactants, having relatively flat, rectangular like, hydrophobic skeleton, usually consisting of 27-30 carbon atoms, and normally one or two hydrophilic glycosyl chains. The hydrophobic (triterpenoid) blocks have tendency to stack and form self-assembled structures, while the glycosyl chains, when packed at high concentration below the surface can form hydrogen bonds, resulting in glassy layers. In addition, due to the axial asymmetry of the head group one can expect the interactions and self-assembly to have some anisotropy as well. All this complexity gives rise to a multitude of interesting properties of these molecules when they self-assemble at interfaces or in bulk, both as pure components or in presence of other biologically relevant lipids like cholesterol, which also has a triterpenoid skeleton, and phospholipids. More interestingly in the late 19th century, Lord Rayleigh has used saponins to settle a dispute between Plateau and Marangoni on the existence of surface viscosity and also to outline advantages of various experimental methods for measuring rheological proprieties of liquid interfaces, variants of which we are still using today[4].

Despite of the long history of use and the large number of applications saponins are still poorly studied from scientific point of view and up to date, insight into the structure-function relations in saponin and saponin-lipid mixtures is remarkably limited. In this talk we will look at saponins, coming from various plant species, discuss their structure, functionalities and behavior like bulk self-assembly and surface rheological properties [5- 7].

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