Tears of Wine: New Insights on an Old Phenomenon

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Anyone who has enjoyed a glass of wine has undoubtedly noticed the regular pattern of liquid beads that fall along the inside of the glass commonly referred as 'tears of wine.' This fascinating phenomenon is possible only if there is a flow against gravity in the liquid film that forms on the inside of the glass. In 1855, J. Thomson identified the driving force for the upwards flow necessary for the continuous formation of tears as a gradient in interfacial tension, now known as a Marangoni stress. It is generally accepted that the flow leading to wine tears is due to a composition gradient that results from the evaporation of ethanol, which in turn produces an interfacial tension gradient. Here, we revisit the tears of wine phenomenon using a simple hydrodynamic model and a novel experimental technique. Our results demonstrate that the Marangoni force responsible for wine tears is the result of both composition and temperature gradients whose relative contribution depends on the bulk ethanol concentration. The model predicts the range of ethanol concentration for which wine tears are observed, which is strongly influenced by the thermodynamic behavior of ethanol-water mixtures