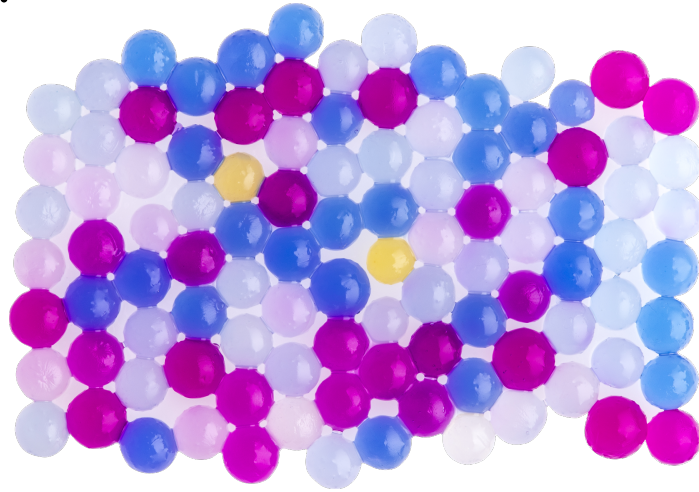


Ionic diffusion in spherified calcium alginate gels

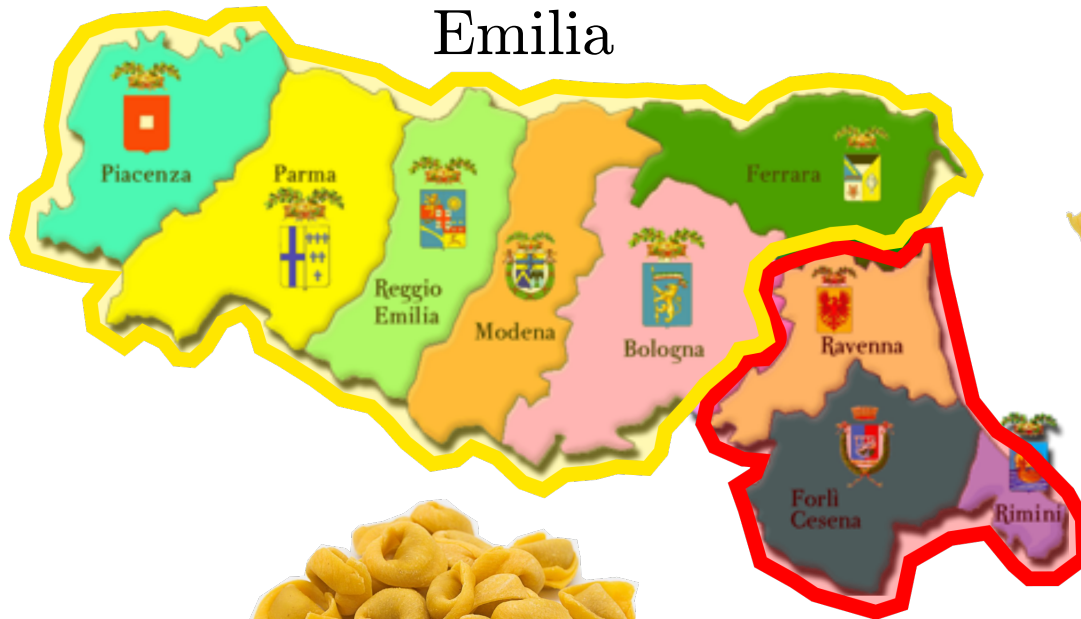
A laboratory experiment using molecular diffusion to show that gels are dispersed systems which at the same time behave both as liquids and solids.



Lorenzo Soprani, Lara Querciagrossa, Silvia Cristofaro, Luca Muccioli, Silvia Orlandi, Elena Strocchi, Alberto Arcioni, Roberto Berardi

Emilia-Romagna

a culinary war



Emilia

Cappelletti

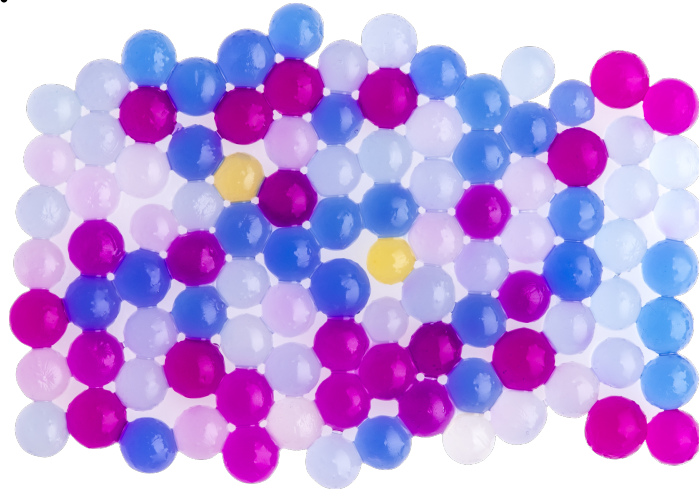


Romagna

Tortellini

Ionic diffusion in spherified calcium alginate gels

A laboratory experiment using molecular diffusion to show that gels are dispersed systems which at the same time behave both as liquids and solids.



Lorenzo Soprani, Lara Querciagrossa, Silvia Cristofaro, Luca Muccioli, Silvia Orlandi, Elena Strocchi, Alberto Arcioni, Roberto Berardi

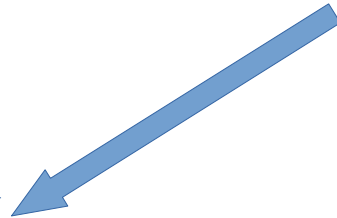
What is alginate?



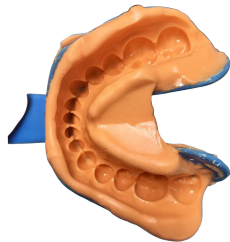
Brown algae



Sodium alginate



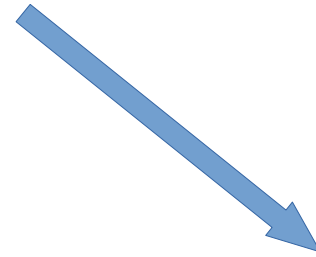
Medicine and
dentistry



Innovative
materials



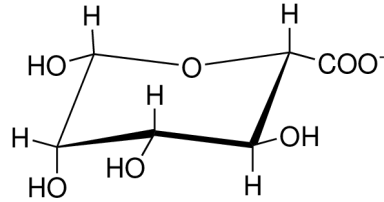
Art



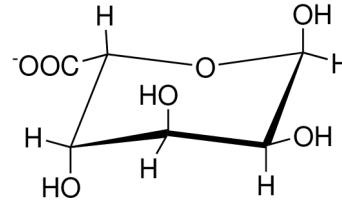
Gastronomy



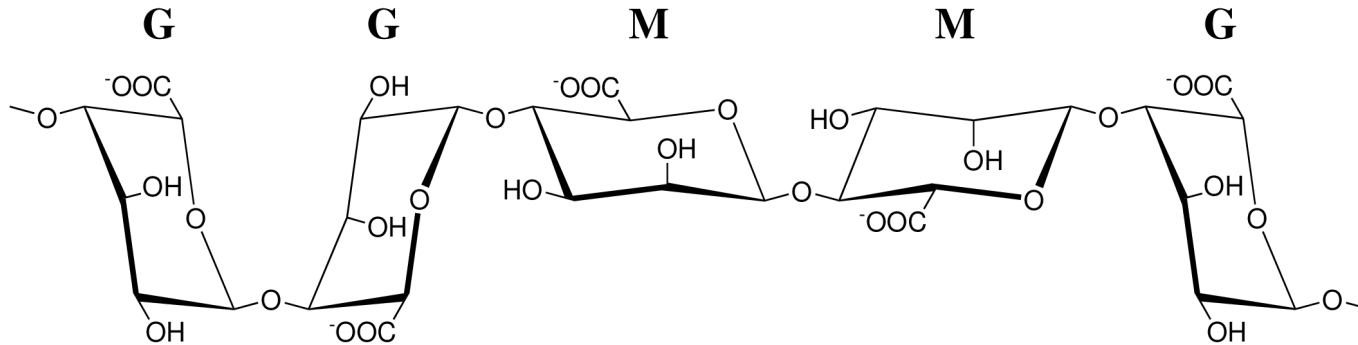
What is alginate?



β -D-mannuronate (**M**)



α -L-guluronate (**G**)



MMMMGMGGGGGMGMGGGGGGGGMMGMGMGMGM

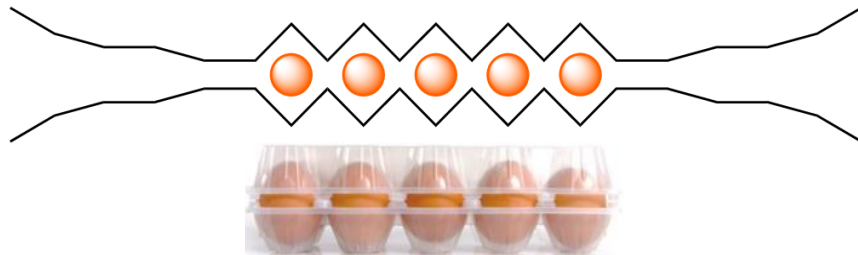
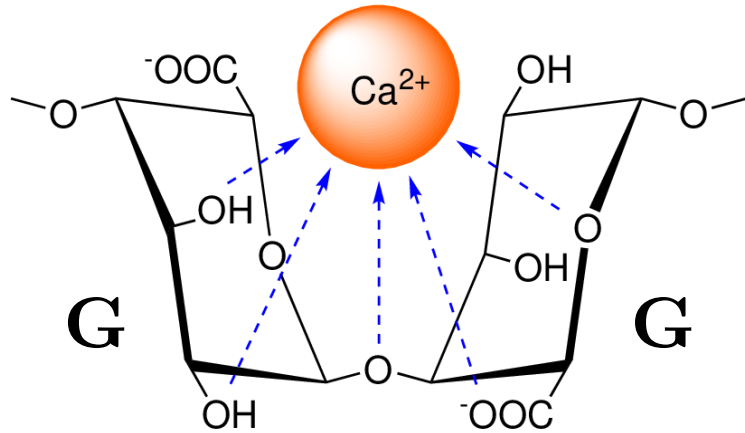
M-block

G-block

G-block

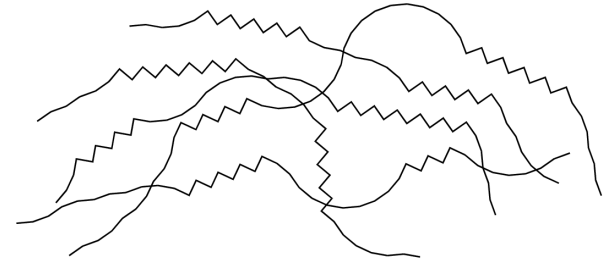
MG-block

Jellyfication

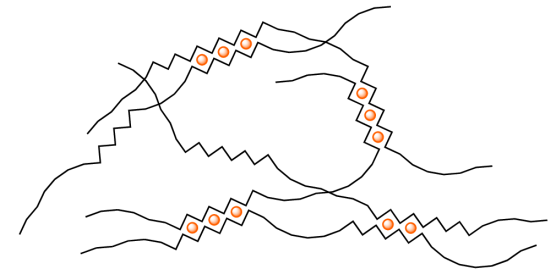


Egg-box structure

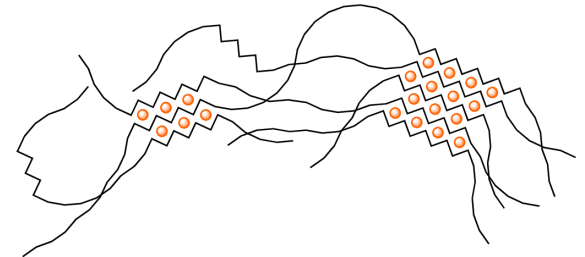
Liquid



Ca^{2+}



Ca^{2+}



Gel

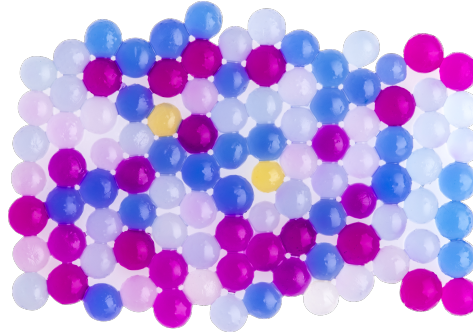
Spherification

Direct method



Sodium
alginate
solution

Ca_nX_m
solution



Indirect method



Sodium
alginate
solution
+
suspension
of CaCO₃

acidic
solution

Experiment flowchart

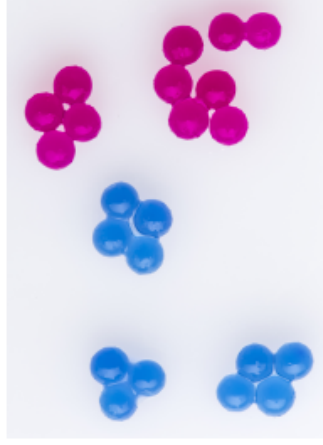
Prepare sodium alginate solution



Drop alginate in basic CaCl_2 solution



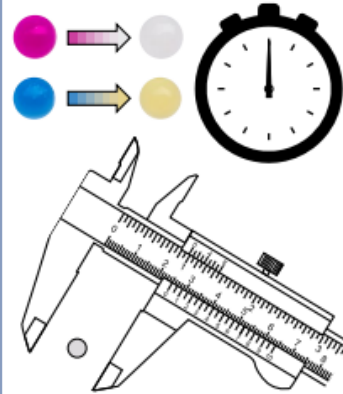
Wait for complete spherification



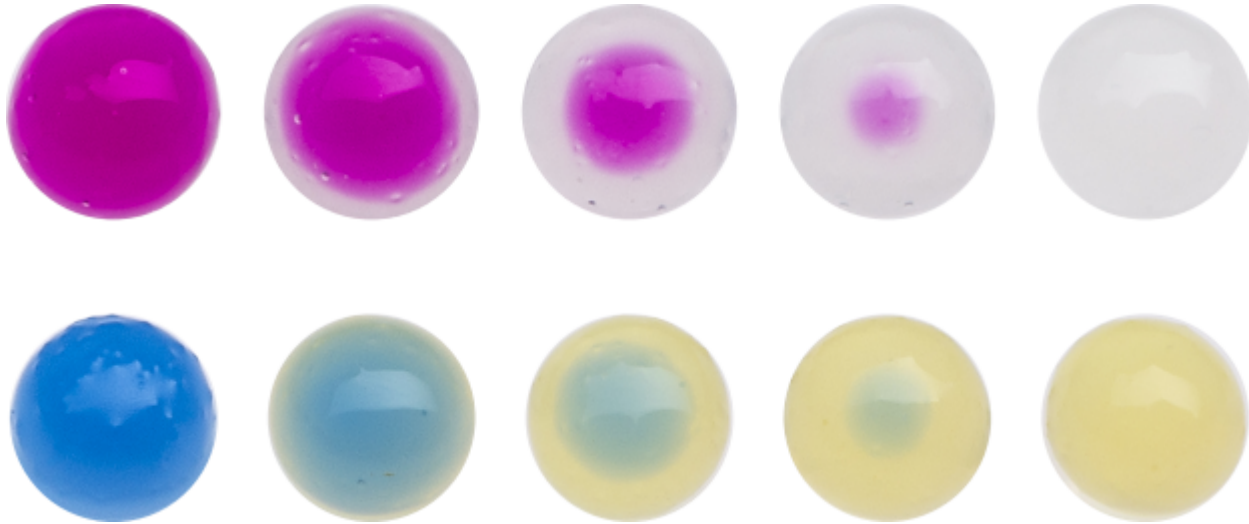
Place drop in solution at low pH



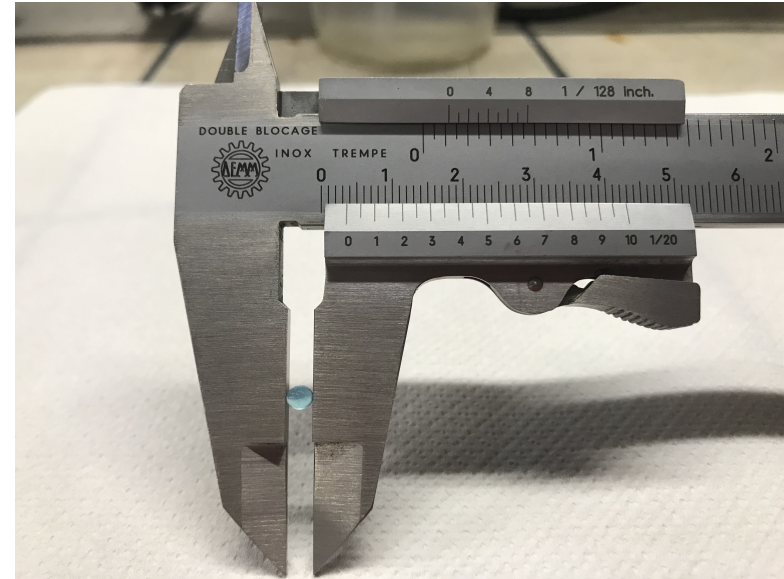
Measure turning times and drop dimensions



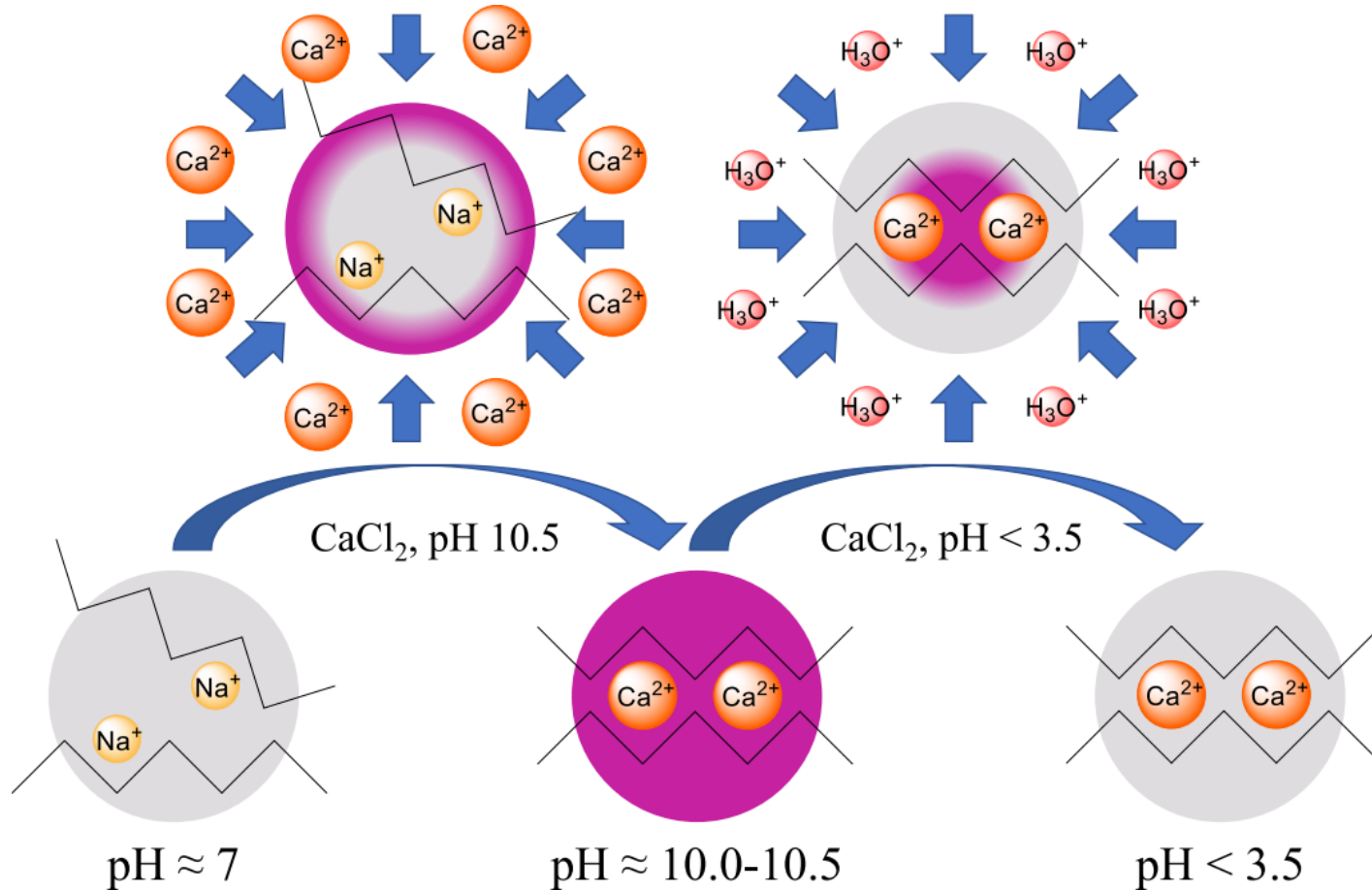
Observations and measurements

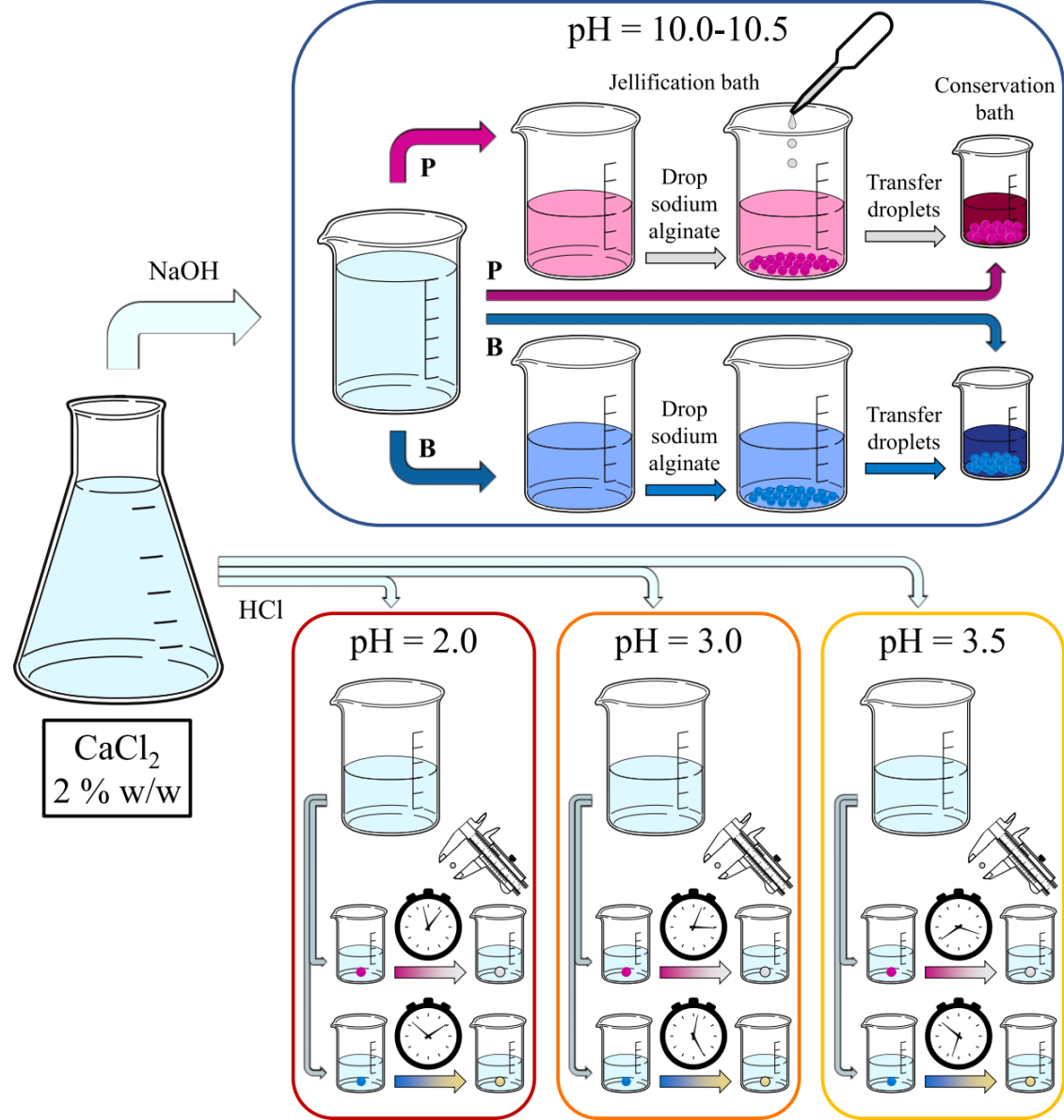


Time



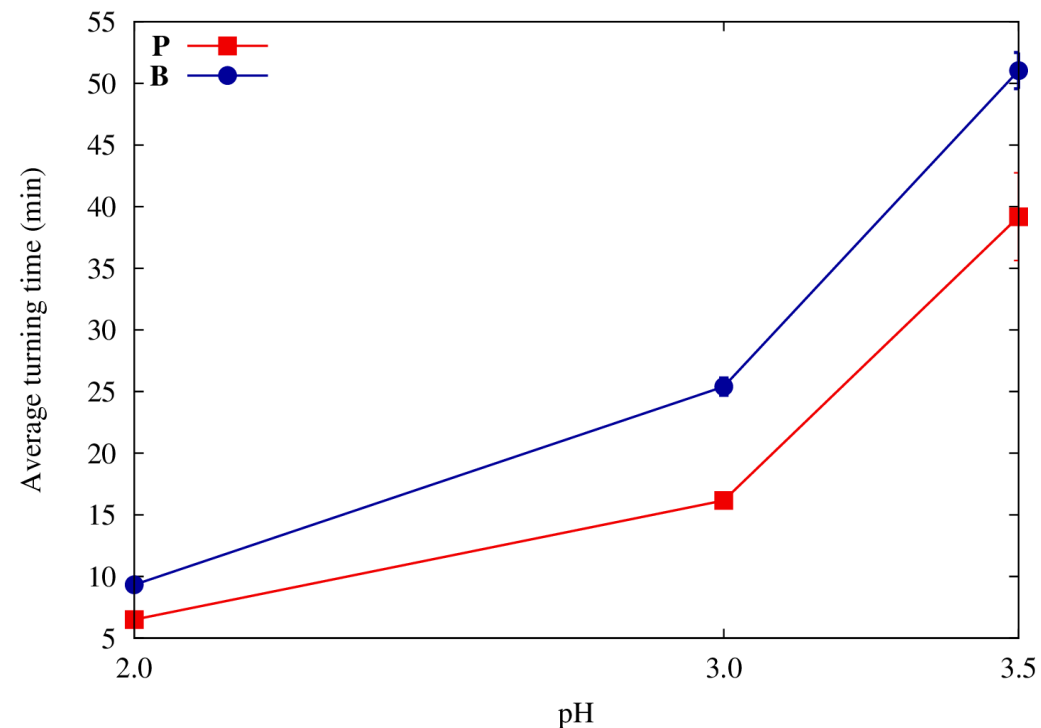
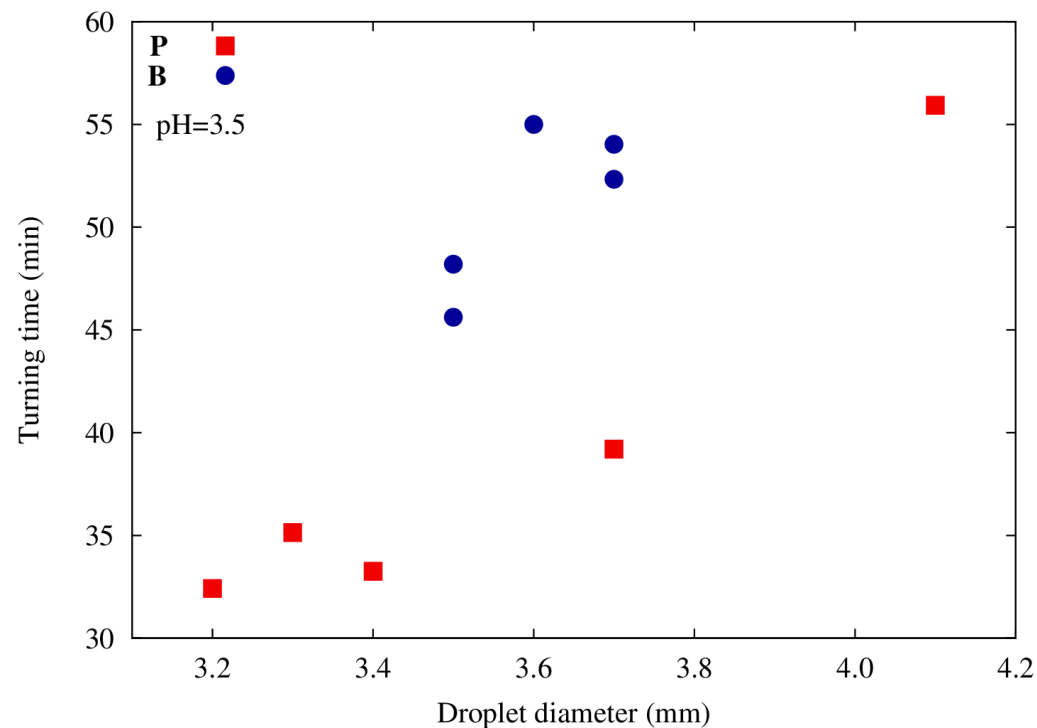
What happens?





Results

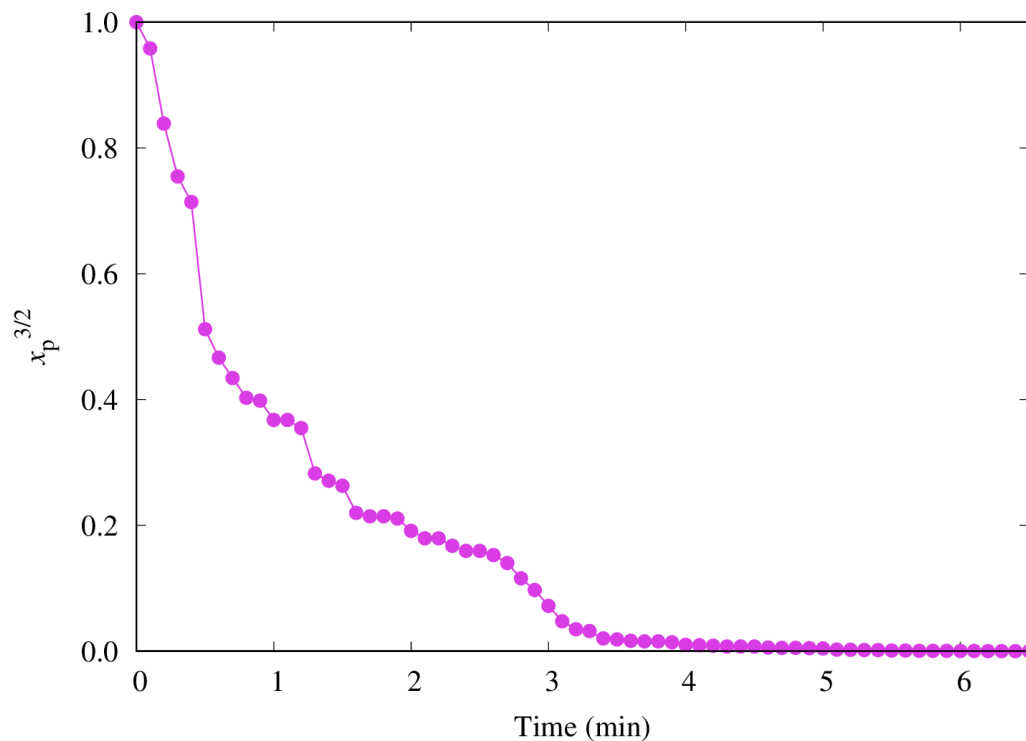
Turning time as a function of diameter and pH



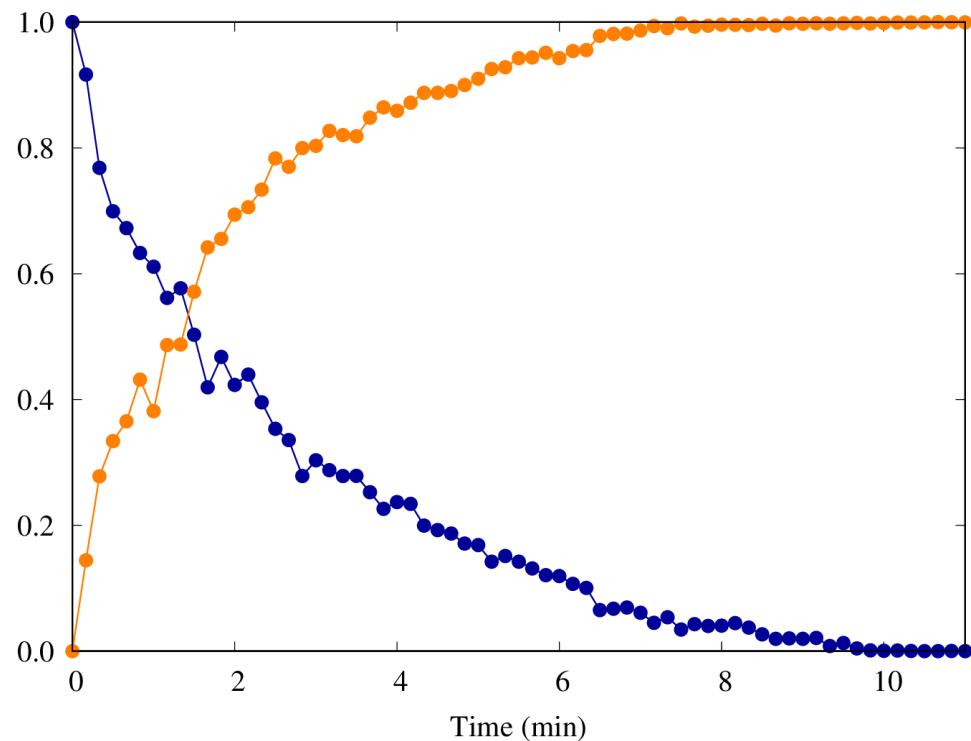
Results

Simulated digitalised spectrophotometric analysis

Phenolphthalein

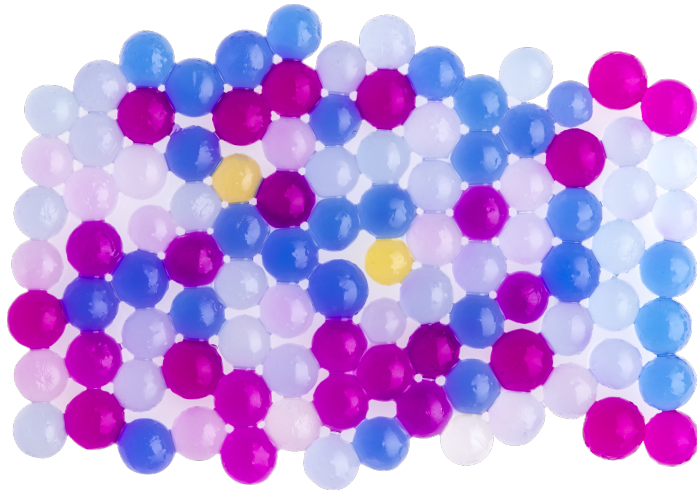


Bromothymol blue

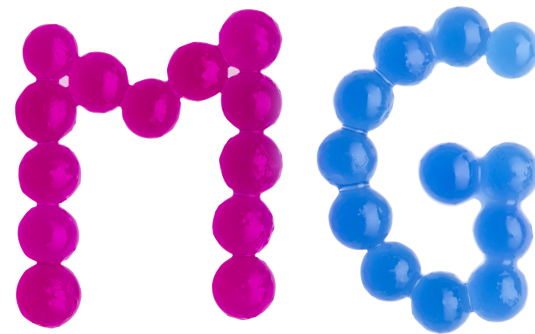


Conclusions

- We described a detailed procedure for an easy and inexpensive didactic laboratory experience to verify that calcium alginate has physical properties associated both with a solid and a liquid.
- The results are roughly consistent with the Fick's law



Thank you!



- Marco Fortini - Studio Fotografico Marco Fortini (<http://www.marcofortini.com/>).
- Sandra Stipa, Alberto Mucchi and Stefano Cerini - Department of Industrial Chemistry “Toso Montanari”, University of Bologna.
- Nicola Howcroft, Newgen Publishing UK.
- Róisín Burke, Alan Kelly, Christophe Lavelle and Hervé This vo Kientza, editors of Handbook of Molecular Gastronomy.
- All the other authors!

In loving memory of Bebo

