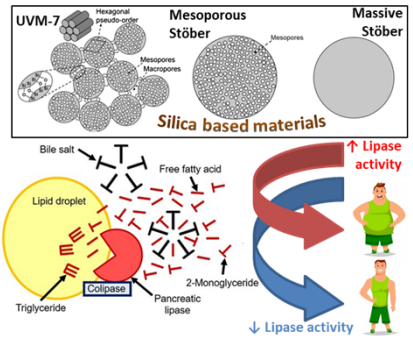
# Modulation of the Lipase Catalyzed Hydrolysis of Fats under Simulated Duodenal Conditions

Sara Muñoz-Pina[1], Pedro Amorós[2], Jamal El Haskouri[2], Ana Andrés[3] and José Vicente Ros-Lis[1]*

[1]Redolí Group, Departament de Quimica Inorgànica, Universitat de València, Dr. Moliner 50, 46980 46100 Burjassot, Valencia, Spain
[2]Institut de Ciència dels Materials (ICMUV), Universitat de València, Catedrático José Beltrán 2, 46980 Paterna, Valencia, Spain
[3]Instituto Universitario de Ingeniería de Alimentos para el Desarrollo (IUIAD-UPV), Universitat Politècnica de València Camino de Vera s/n, 46022 Valencia, Spain
*J.Vicente.Ros@uv.es

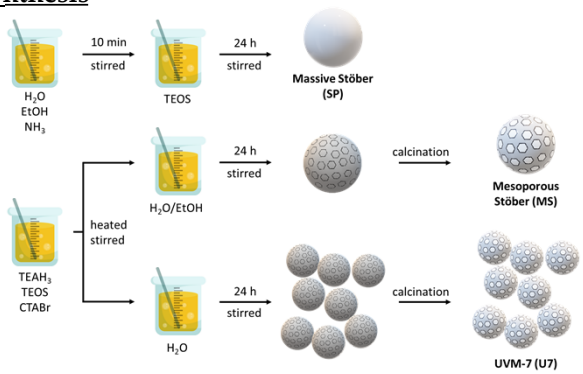
## INTRODUCTION AND OBJECTIVE

- ✓ Digestion is a complex action involving chemical, physical and biological processes. The hydrolysis and the absorption of fats occurs in the small intestine when the pancreatic lipase breaks down fat into fatty acids and glycerol.
- ✓ Fat hydrolysis is a key factor in relevant diseases such as obesity and cystic fibrosis when the enzyme supply is either overcome or deficient respectively.
- ✓ Different silica materials were prepared and their effect on the fat hydrolysis was measured under simulated duodenal conditions.

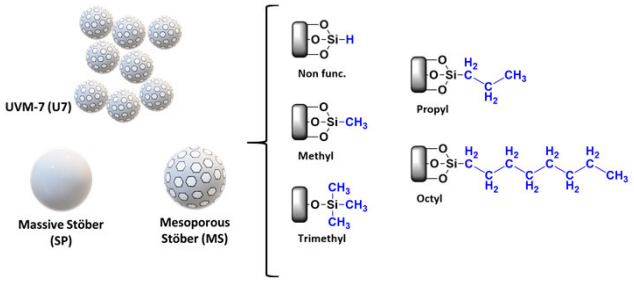



## METHODOLOGY

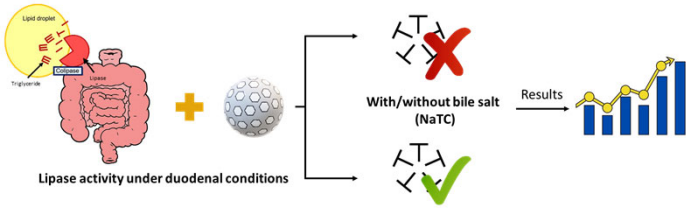
### ❑Synthesis




### ❑Functionalization




### ❑Lipase activity assay




## RESULTS

### ❑Material characterization

| Material | Support | Functional Gruop | Area ($m^2g^{-1}$) | mmol/ g $SiO_2$ |
|---|---|---|---|---|
| U7 | UVM-7 | - | 1146 | - |
| U7-$C_1$ | UVM-7 | Methyl | 992 | 3.32 |
| U7-$C_3$ | UVM-7 | Propyl | 1028 | 1.05 |
| U7-$C_8$ | UVM-7 | Octy | 974 | 0.47 |
| U7-3$C_1$ | UVM-7 | Trimethyl | 865 | 1.82 |
| SP | SNP | - | - | - |
| SP-$C_1$ | SNP | Methyl | - | 2.09 |
| SP-$C_3$ | SNP | Propyl | - | 1.13 |
| SP-$C_8$ | SNP | Octyl | - | 0.32 |
| SP-3$C_1$ | SNP | Trimethyl | - | 1.34 |
| MS | MSNP | - | 1231 | - |
| MS-$C_1$ | MSNP | Methyl | 1088 | 1.95 |
| MS-$C_3$ | MSNP | Propyl | 1198 | 0.93 |
| MS-$C_8$ | MSNP | Octyl | 1136 | 0.28 |
| MS-3$C_1$ | MSNP | Trimethyl | 1190 | 1.27 |

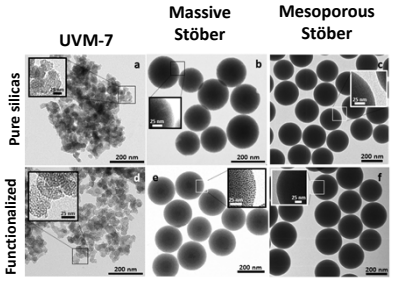



**Figure 1.** A) Textural properties and organic content of the silica based materials. B) TEM images of the pure silica-based materials a) UVM-7, b) MSNP and c) SNP, and selected modified materials functionalized with chlorotrimethylsilane d) U7-3C1, e) MS-3C1 and f) SP-3C1. Images with higher magnification are shown in the insets showing the porous (U7, U7-3C1, MS and MS-3C1) or massive (SP and SP-3C1) nature of the materials.

**Morphology and mesostructure preservation after functionalization**

### ❑Effect of the Materials in the Fat Hydrolysis

Lipase activity can be modulated using functionalized silica materials. Functionalized massive Stöber and UVM-7 tend to decrease lipase activity either in presence or absence of the bile salt. However, mesoporous Stöber particles enhance the lipase activity in the absence of the surfactant, reaching up to a 120% of fat hydrolysis.

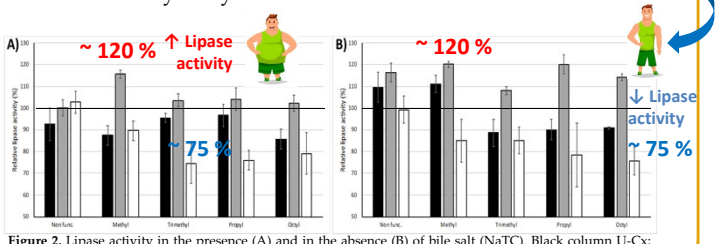



**Figure 2.** Lipase activity in the presence (A) and in the absence (B) of bile salt (NaTC). Black column U-Cx; Grey column MS-Cx and white column SP-Cx

## CONCLUSION

Silica hybrid nanomaterials have great potential as new modulators of the digestive activity. Both the textural structure and their surface functionalization are key factors over the fat hydrolysis control, either increasing or reducing it, under duodenal conditions . Depending of the material, relative fat hydrolysis rate of 75 to 140% in comparison with absence of material were obtained. The effects are more pronounced for materials containing long alkyl chains and/or in absence of NaTC.

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