Modulation of Extra Virgin Olive Oil Digestibility through Oleogelation

ICFD 2022
CORK 3-5 MAY 2022

MODULATION OF EXTRA VIRGIN OLIVE OIL DIGESTIBILITY THROUGH OLEOGELATION

F. Ciuffarin, M. Alongi*, S. Calligaris, M.C. Nicoli
Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, Italy
* marilisa.alongi@uniud.it

Background

The development of a **SUSTAINABLE FOOD SYSTEM,** to favor the **TRANSITION TO HEALTHIER AND MORE SUSTAINABLE DIETS,** is one of the major challenges of the modern food industry [1].

The use of extra virgin olive oil (**EVOO**) as a **FUNCTIONAL INGREDIENT** would be particularly interesting due to its recognized health-promoting capacity [2]. However, the direct addition of EVOO to food is challenging due to its liquid state.

Liquid oil conversion into a solid-like material through **OLEOGELATION** could enlarge its possible applications, increasing the technological performances, while reducing hard stock fat content in food [3].

AIM

To understand the digestibility of EVOO triglycerides in oleogels obtained by different oleogelators

Material & Methods

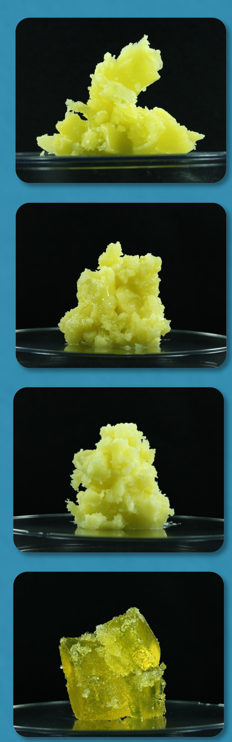
EVOO
90% (w/w)

+

- Monoglycerides (MG)
- Rice Bran Wax (RW)
- Sunflower Wax (SW)
- β-sitosterol/γ-oryzanol mixture (PS)

10% (w/w)

=



Polarized Light Microscopy (PLM)
+
Firmness
+
Rheology (stress sweep)

OLEOGEL PREPARATION and PHYSICAL CHARACTERIZATION

***IN-VITRO* DIGESTION**

Infogest Protocol [4]

After the intestinal phase **pH-stat protocol** was performed to **assess Free Fatty Acid release** (FFA) [5]

$$FFA\ (\%) = \frac{V_{\ NaOH\ over\ time}}{V_{\ total\ teoric\ NaOH}} * 100$$

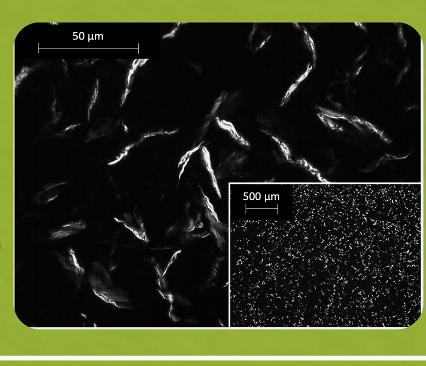
+

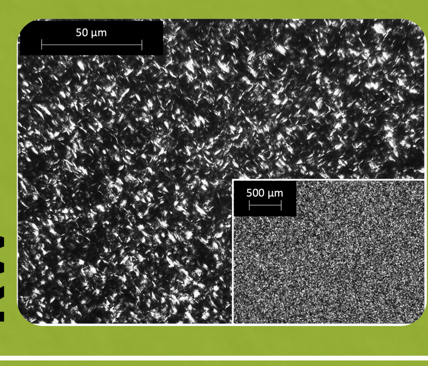
Confocal Light Scattering Microscopy (CLSM)

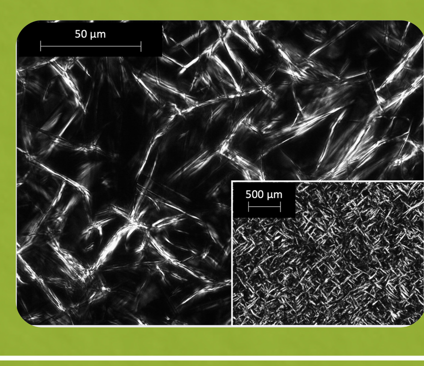
Results & Discussion

MICROSCOPIC APPEARANCE

PLM showed **needle-like crystals** in MG, SW, and RW of different sizes.
PS is not recordable with PLM being a fibrillar network.

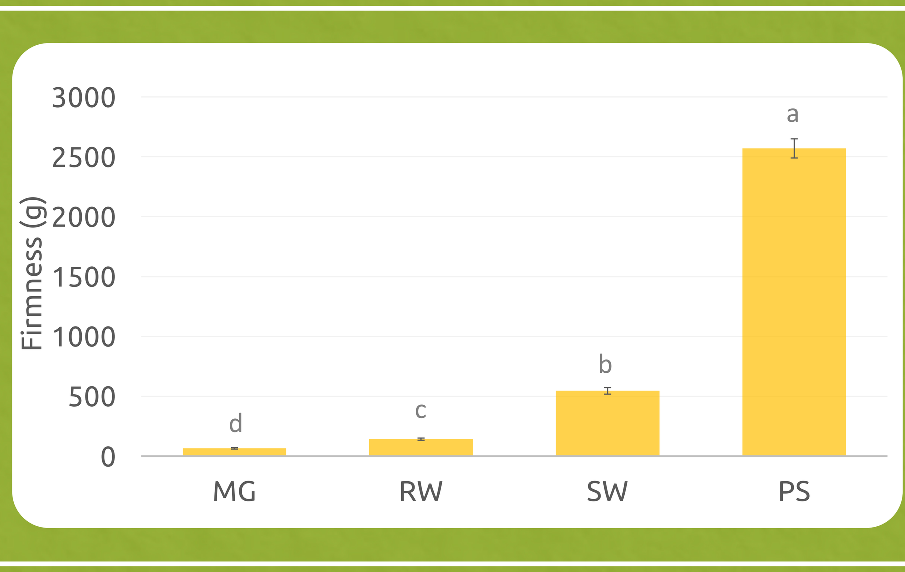
MG


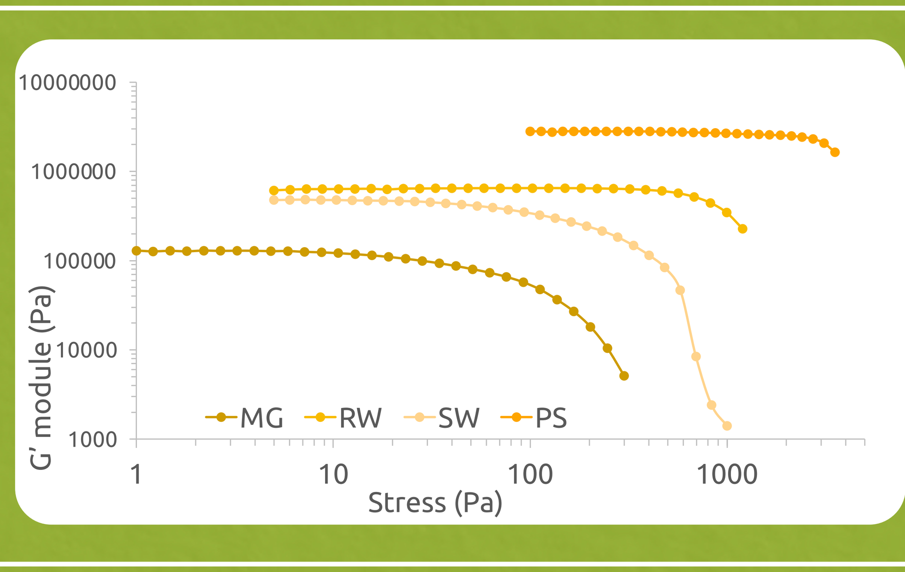
RW


SW


MECHANICAL BEHAVIOUR

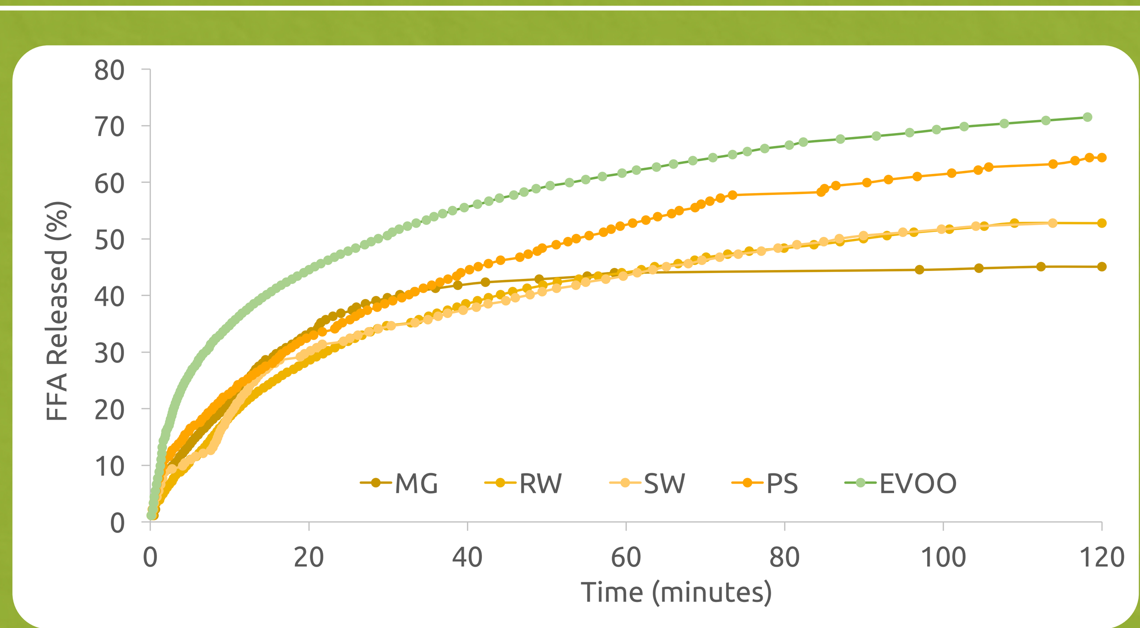
Both firmness and critical stress indicated that PS was the strongest gel, followed by SW, RW, and MG. These results were attributed to **the microstructure and the nature of the network**, i.e., fibrillar (PS) or crystalline (MG, RW, and SW).



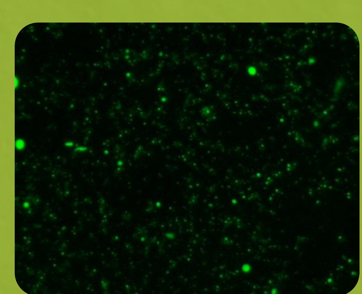
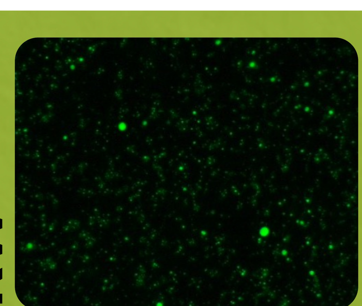
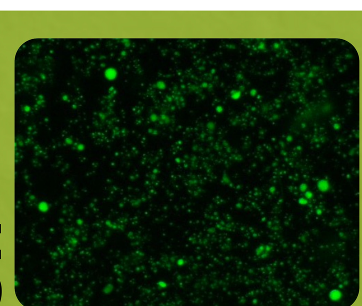
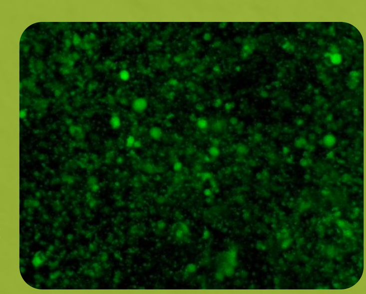
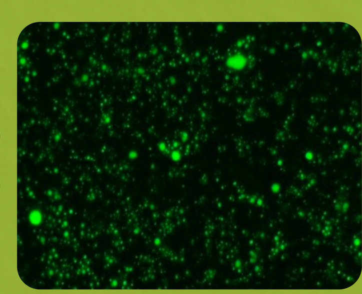


DIGESTION BEHAVIOUR

The kinetics of FFAs released differed among samples. All oleogels presented a **lower lipid digestibility** compared to unstructured EVOO. Different structures led to changes in lipid digestibility: MG had the lowest while PS had the highest FFA release values.
CLSM highlighted the effect of different gelators on the **formation of mixed micelles** upon intestinal in-vitro digestion.
Larger oil droplets were observed in EVOO and PS, whereas MG, RW, and SW enabled the formation of smaller and more dispersed micelles.



Sample	FFA Released (%)
MG	42.88 ± 3.11
RW	50.72 ± 2.92
SW	50.86 ± 2.33
PS	59.10 ± 0.78
Liquid EVOO	67.90 ± 5.55

MG

RW

SW

PS

EVOO


Conclusions

All **gelators** (MG, RW, SW, and PS) **successfully structured EVOO into oleogels** with peculiar physical characteristics. This can enlarge the possible applications of **EVOO in food formulations**.

The entrapment of liquid oil into oleogel networks based on different microstructures allowed **modulating FFA release** during in vitro digestion. Oleogels can thus represent a **promising strategy to tailor lipid digestibility**.

References

[1] European Commission. *Farm to Fork Strategy.*; 2020.
[2] A. Romani et al., "Health effects of phenolic compounds found in extra-virgin olive oil, by-products, and leaf of olea europaea L.," Nutrients, vol. 11, no. 8, 2019.
[3] Marangoni AG, Garti N. *Edible Oleogels: Structure and Health Implications.* Elsevier Inc.; 2011.
[4] Brodkorb A, Egger L, Alminger M, et al. INFOGEST static in vitro simulation of gastrointestinal food digestion. Nature Protocols. 2019;14(4):991-1014.
[5] Ahmed K, Li Y, McClements DJ, Xiao H. Nanoemulsion- and emulsion-based delivery systems for curcumin: Encapsulation and release properties. Food Chemistry. 2012;132(2):799-807.

7th International Conference on Food Digestion