



**HAL**  
open science

## Enzymatic digestion of heterogeneous plant galactolipid assemblies by pancreatic lipase related-protein 2 (PLRP2)

Jeanne Kergomard, Frédéric Carrière, Gilles Paboeuf, Lauriane Chonchon, Nathalie Barouh, Véronique Vié, Claire Bourlieu-Lacanal

### ► To cite this version:

Jeanne Kergomard, Frédéric Carrière, Gilles Paboeuf, Lauriane Chonchon, Nathalie Barouh, et al.. Enzymatic digestion of heterogeneous plant galactolipid assemblies by pancreatic lipase related-protein 2 (PLRP2). Journées Chevreul 2023, Jan 2023, Paris, France. hal-03953854

**HAL Id: hal-03953854**

**<https://hal.science/hal-03953854v1>**

Submitted on 24 Jan 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NoDerivatives 4.0 International License

# ENZYMATIC DIGESTION OF HETEROGENEOUS PLANT GALACTOLIPID ASSEMBLIES BY PANCREATIC LIPASE RELATED-PROTEIN 2 (PLRP2)

Jeanne Kergomard<sup>1,2</sup>, Frédéric Carrière<sup>3</sup>, Gilles Paboeuf<sup>1</sup>, Lauriane Chonchon<sup>1</sup>, Nathalie Barouh<sup>4,5</sup>, Véronique Vié<sup>1\*</sup> & Claire Bourlieu<sup>2\*\*</sup>

<sup>1</sup>IPR Institute of Physics, Rennes 1 University, France; <sup>2</sup>INRAE/UM/Institut Agro Montpellier UMR 1208 IATE, France; <sup>3</sup>Aix-Marseille Université, CNRS, UMR7281 Bioénergétique et Ingénierie des Protéines, Marseille, France; <sup>4</sup>CIRAD, UMR QUALISUD, F34398 Montpellier-France; <sup>5</sup>Qualisud, Univ Montpellier, Avignon Université, CIRAD, Institut Agro, Université de La Réunion, Montpellier, France.

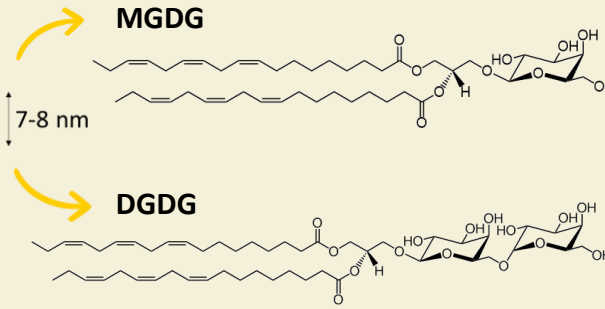
Kergomard et al., Biochimie 2022 - under review

## Context

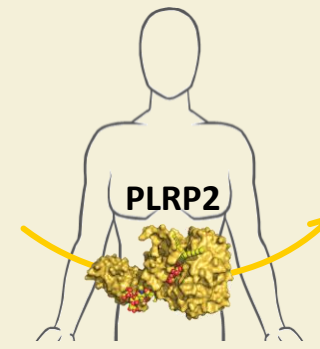


PLRP2 is responsible for the **effective hydrolysis of galactolipids** in human digestive system, leading to the production of **essential  $\omega$ 3 fatty acids**. Besides chemical conditions, the PLRP2 adsorption has also been shown to be **modulated by the physical environment** of the substrate. Yet, PLRP2 adsorption and enzymatic activity has not been deeply investigated on biomimetic heterogeneous vegetal membranes containing **galactolipids**.

## Photosynthetic plant membranes



## Degradation and adsorption in the human digestive system



Free fatty acids  
(ALA, EPA, DHA)  
(C18:3, C20:5, C22:6)

Essential  $\omega$ 3  
(2.2 g/day, ANSES)

Sahaka et al, 2020

**Objectives:** to understand the **impact of the physical environment** on the adsorption and lipolytic activity of PLRP2 onto **heterogeneous biomimetic vegetal membrane** of increasing complexity using complementary biophysical tools (tensiometry, ellipsometry, atomic force microscopy) and *in vitro* static digestion.

## Material and methods

\*brassicasterol<sub>10</sub>/campesterol<sub>40</sub>/ $\beta$ -sitosterol<sub>40</sub>

### Model systems

- 1 GL**  
MGDG/DGDG  
60:40 mol%  
Homogeneous
- 2 GL/DPPC/pS**  
MGDG/DGDG/DPPC/pS\*  
27:18:45:10 mol%  
Heterogeneous
- 3 MGDG/DGDG/SQDG/PG**  
MGDG/DGDG/SQDG/PG  
56:24:10:10 mol%  
Biomimetic

### Molecular scale (nm)

Interfacial characterization  
in Langmuir trough



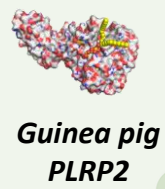
Lipid monolayers

### Assembly scale ( $\mu$ m)

Static *in vitro* model  
(mL) - Bulk

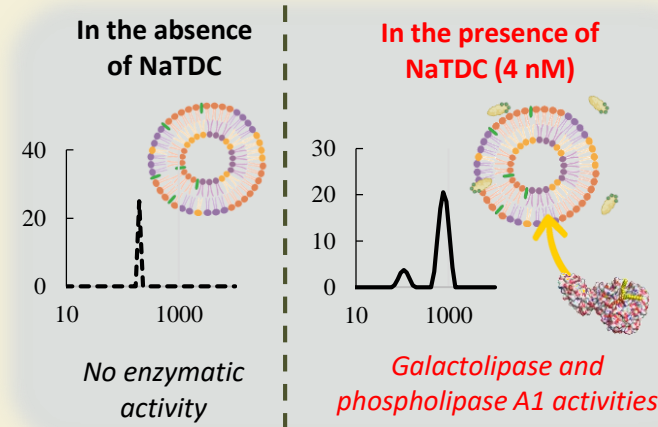


Giant liposomes

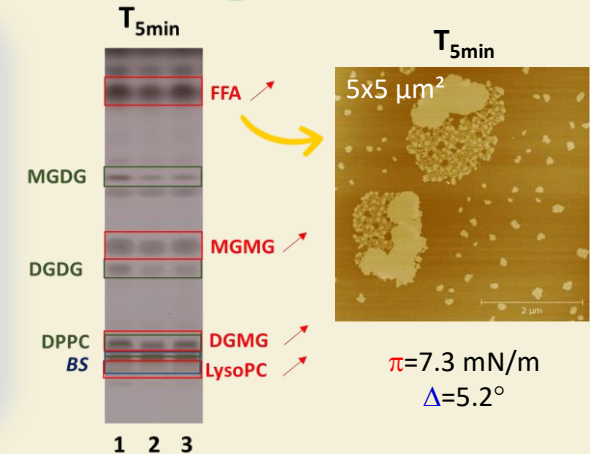


## Results

### Assembly scale ( $\mu$ m)



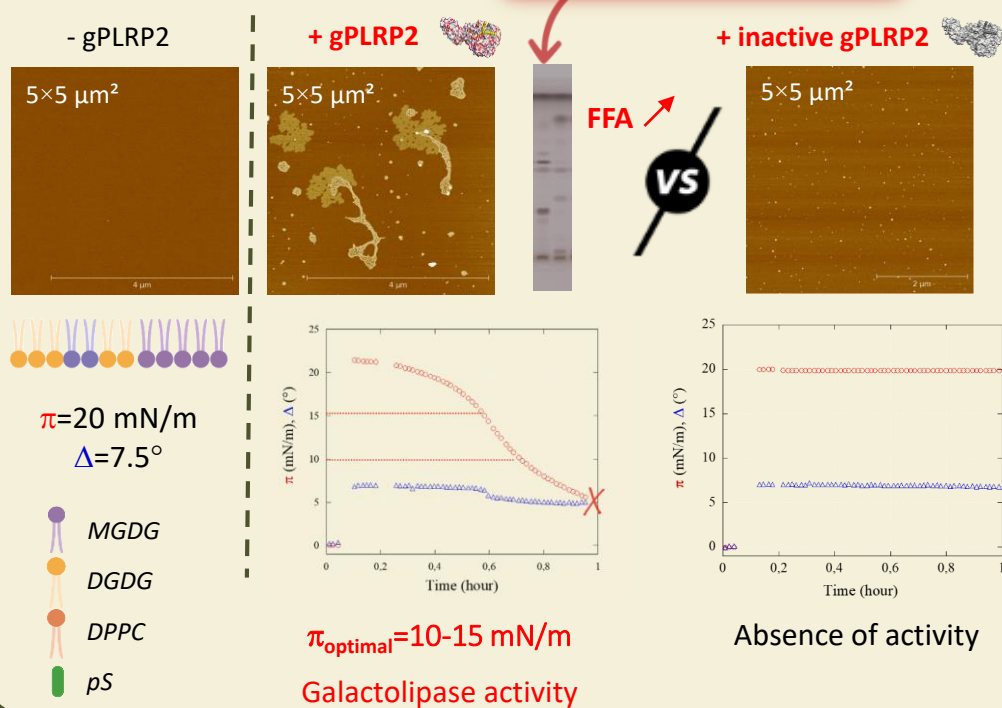
### 2 GL/DPPC/pS



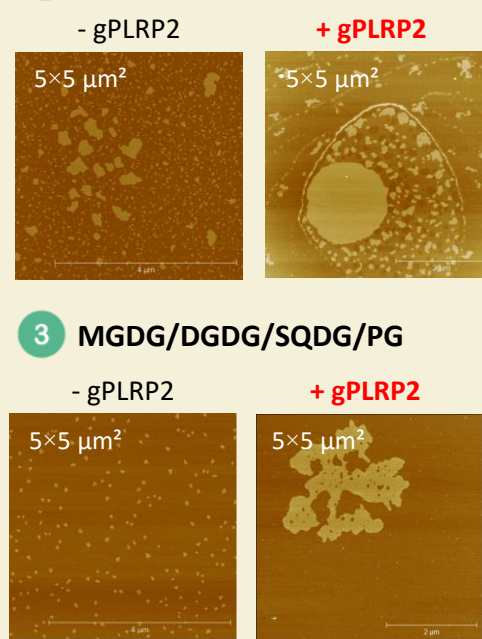
**Conclusion:** In bulk, **no enzymatic activity** on GL-based liposomes in the absence of bile salts. In the presence of NaTDC (4 mM), gPLRP2 showed both **high galactolipase** and **moderate phospholipase A1** activities on liposomes, probably due to a decrease in packing and lateral pressure upon NaTDC adsorption, and subsequent disruption of liposomes.

## Results

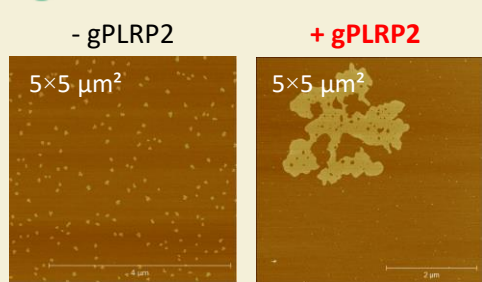
### 1 GL



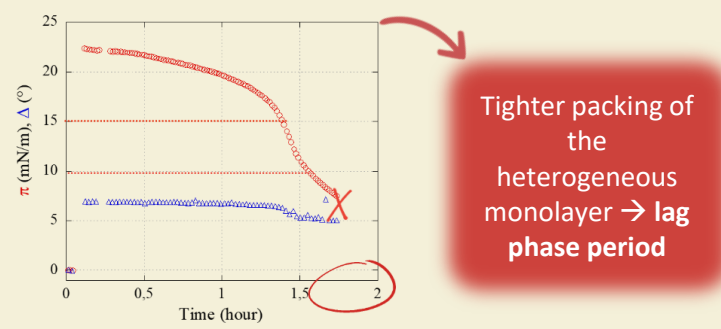
### 2 GL/DPPC/pS



### 3 MGDG/DGDG/SQDG/PG



### Molecular scale (nm)



**Conclusion:** The galactolipase activity of gPLRP2 was evidenced at the level of **both homogenous and heterogeneous** GL-based monolayers. The presence of **charged lipids** (SQDG, PG) at the interface **improved the adsorption capacities** of the enzyme. The **optimal activity** of gPLRP2 was obtained in a range of surface pressure of **10-15 mN/m**.

Kergomard et al., 2021

**Conclusions:** Galactolipase and phospholipase A1 activities of gPLRP2 have been shown on **model GL-based monolayers**, but also on **liposomes** in presence of bile salts. It is now tempting to investigate whether gPLRP2 can act **directly on plant membranes**. Indeed, the galactolipase activity of PLRP2 at the level of natural membrane assemblies could open the way to the development of plant-based dietary alternatives to vectorize  $\omega$ 3 PUFA, and contribute to the rebalancing of human and animal diets.

Infantes-Garcia et al., 2022  
Mateos-Diaz et al., 2018

\*Corresponding authors: [jeanne.kergomard@orange.fr](mailto:jeanne.kergomard@orange.fr), [claire.bourlieu-lacanal@inrae.fr](mailto:claire.bourlieu-lacanal@inrae.fr), [veronique.vie@univ-rennes1.fr](mailto:veronique.vie@univ-rennes1.fr)