doi:10.20396/revpibic.v0i0.id

XXVI Congresso de Iniciação Científica Unicamp
17 a 19 de outubro Campinas | Brasil

Tailoring the gastrointestinal fate of emulsions through interfacial engineering: Impact of lipid type and coating lipid droplets with protein-surfactant mixture

Dayane Dias Cardoso*, Andresa Gomes, Rosiane Lopes da Cunha

Abstract
The bioaccessibility of bioactives incorporated in oil-in-water (O/W) emulsions may be modulated by controlling emulsion structure through the rational selection of an oily phase and emulsifier or mixture of emulsifiers. In this context, emulsions were produced with protein-surfactant mixtures and different oils to understand how the nature of ingredients and the interaction between them can affect the structure of emulsions and their behavior during digestion in vitro.

Key words:
Lipolysis, emulsifiers mixture, ingredients engineering.

Introduction

Oil-in-water (O/W) emulsions are widely used to encapsulate, protect and deliver lipophilic functional bioactive compounds. However, the bioaccessibility of bioactives may be modulated by controlling emulsions structure through the choose of their ingredients. In this context, the engineering of ingredients appears as a strategy to design emulsified products aiming modulate the lipolysis and, therefore, delivery efficiency of bioactives. Over the recent years, the individual effect of different emulsifiers and oily phases on the emulsion digestion has been subject of research. However, to the best of our knowledge, none of the manuscripts were dedicated to evaluate how the interaction between the hydrophobic phase and interfacial layer formed by protein-surfactant mixture may affect the lipid hydrolysis. Therefore, the objective of this work was to produce O/W emulsions with WPI-Tween 80 (T80) mixtures and different oily phases to understand the role of these variables on the release rate of free fatty acids (FFAs).

Results and Discussion

Emulsions were produced by pre-mixing the oily phase (Sunflower oil - LCT or NEOBEE® 1053 - MCT) and aqueous phase (solutions of WPI/T80 in the ratios 1.0/0, 0.9975/0.0025, 0.75/0.25, 0.5/0.5 and 0/1.0 % w/w) using an Ultra Turrax-T18 (IKA, Staufen, Germany) followed by homogenization with a Panda 2KNS1001L double-stage homogenizer (Niro Soavi, Parma, Italy). Emulsions were evaluated from optical microscopy, mean droplet size (D_{43}), ζ-potential and digestibility by *in vitro* method (INFOGEST[1]). D_{43} decreased increasing the T80 concentration. Proteins adsorb slower (higher molecular weight) on the interface oil-water, but form a solid viscoelastic interfacial film more resistant to disruption. Otherwise, T80 are more surface-active than WPI and forms a fluid layer, which allows its rapid migration (Marangoni mechanism) facilitating the production of smaller droplets. Larger D_{43} was observed in LCT-systems due higher viscosity and hydrophobicity of LCT than MCT. In the stomach step, emulsions with higher WPI-concentration showed flocculation and coalescence of droplets due the pH decrease and pepsin action resulting in droplets with lower interfacial area for lipase action in the intestine. These phenomena were not observed in LCT-system with 0.5%WPI and in MCT-system with 0.75%WPI, showing the strong T80 influence on the interfacial layer. T80 is not sensitive to pH change and pepsin, besides presenting some bile salts-lipase resistance. T80 concentration necessary to avoid the flocculation was lower to MCT-emulsions, since WPI adsorbed onto less hydrophobic interfaces can be more easily replaced by T80 (competitive adsorption). However, the proteolysis is more susceptible in the MCT-interfaces. The interfacial composition did not affect the free fatty acid release rate in MCT-systems (Figure 1). Medium-chain FFAs do not accumulate at the interface inhibiting the lipase because they present higher water solubility. LCT-emulsions with higher WPI concentration showed higher release rate of FFAs, because WPI can be more easily displaced from the interface by bile salts-lipase. However, the system with 0.5%WPI presented similar release rate of FFAs than 1%WPI. In this condition, T80 may have worked maintaining emulsion stability in the stomach, while the protein facilitated the lipase action in the intestine.

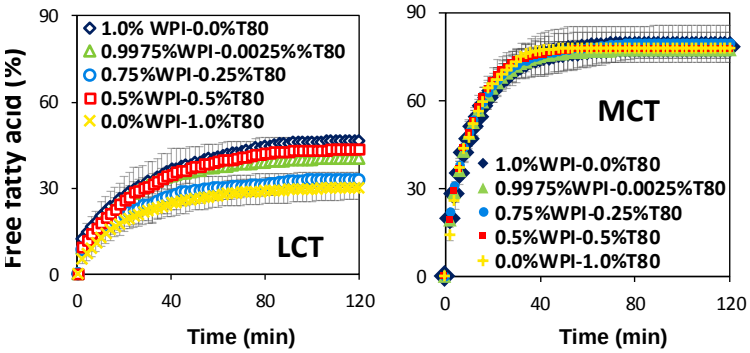

Figure 1. FFAs released rate in O/W emulsions during enteric phase.

Conclusions

Oil type and WPI-T80 mixture in different ratios influenced the droplet size of the fresh emulsions and also their behavior in the gastric and enteric phase. Emulsions with higher WPI concentrations was more sensitive the stomach step. Lipid hydrolysis of MCT-emulsions was more influenced for the chain size of FFAs. Differently, a synergetic effect was obtained with 0.5%WPI/0.5%T80 blend in LCT-system since this system showed the same release rate of FFAs than 1%WPI-system. The results aforementioned reinforce the importance of rational selection of ingredients to design systems aiming to promote enhanced bioactive bioaccessibility.

Acknowledgement

Authors thank CNPq-Brazil for fellowships (137438/2017-6 and 140705/2015-5) and productivity grant (307168/2016-6).

[1] Minekus, M., et al. A standardized static in vitro digestion method suitable for food-an international consensus. *Food and Function*. **2014** 5(6):1113-1124.