**IMAS MASTER Academic Year 2023 - 2024**

**Proposal of M2 Internship**

**PROJECT TITLE AND SUMMARY:**

**Title:** Update of an in vitro digestion model protocol - application to carotenoid bioaccessibility measurement

**Summary:** Carotenoids are fat-soluble pigments synthesized by photosynthetic organisms and are responsible for colours ranging from red to yellow. Humans cannot synthesize them and as a consequence, they primarily obtain them from vegetables and fruits. Carotenoids are compounds with antioxidant properties and their dietary intake and plasma concentrations have been associated with a decreased risk of several chronic diseases, while some, *i.e.* β- and α-carotene and β-cryptoxanthin, also exhibit provitamin A properties. In order to exert their biological effects, carotenoids must first be extracted from the food matrix and incorporated into mixed micelles in order to be taken up by enterocytes. The bioaccessibility of carotenoids, *i.e.* the relative quantity of carotenoids solubilized in mixed micelles at the end of the digestion, can be low and it is strongly influenced by several factors, *e.g.* carotenoid type, carotenoid formulation, characteristics of the ingested foods, host physiology… Several *in vitro* digestion models, which simulate the physiological conditions of the upper gastrointestinal tract, are used to study the factors modulating carotenoid bioaccessibility. Recently, a consensus model, named Infogest 2.0, has been proposed. However, this model was not specifically designed for the study of carotenoid bioaccessibility and as a consequence, some of its characteristics might not be relevant for it. The objective of the present study is to adapt Infogest 2.0 to the study of carotenoid bioaccessibility by optimizing some of its key parameters, *e.g.* enzyme type and concentration, duration and pH of oral, gastric and intestinal phases… Two carotenoid food sources will be used, *i.e.* carrots and spinach, considering the effect of food processing.

**Activities:**

This work will involve a critical analysis of the scientific literature regarding *in vitro* digestion methods, realization of biological experiments, pre-analytical and analytical processing of generated samples and statistical analyses of data. The student will be involved in the implementation and validation of the new *in vitro* digestion method in the lab. The student will carry out liquid-liquid extraction of the carotenoids from the collected samples and measure their concentration using high performance liquid chromatography. Finally, the trainee will be involved in data analysis.

**HOST UNIT:**

Centre de recherche en CardioVasculaire et Nutrition (C2VN) - https://c2vn.univ-amu.fr/

Aix-Marseille University - INSERM – INRAE

Campus Santé Timone

Marseille

**MAIN ACTIVITIES:**

The work carried out by the group “Bioavailability” of the “Human micronutrion” team of the Center for CardioVascular and Nutrition Research explores the different stages (from digestion to the production of chylomicrons) and the different factors (lipid and non-lipid food intake, food matrix, hormones, factors circulating as free fatty acids, genetic variations, circadian rhythms, drug treatments and bariatric surgery) that govern the absorption and postprandial metabolism of lipids, glucose and lipid micronutrients. It is a world leading team in the field of fat-soluble vitamin and carotenoid absorption and it has a long-standing expertise in in vitro digestions and chemical analysis of lipid micronutrients.

**EXPECTED SKILLS:**

Skills: basic biochemistry lab skills, knowledge in nutrition and in physiology of digestion. Knowledge in analytical chemistry and data analysis would be appreciated. Competence acquired: critical analysis of the bibliography, design and implementation of experiments, *in vitro* digestions, high performance liquid chromatography, statistics, scientific writing methods in English.

**INDEMNISATION:**

- about 600 € / month

**CONTACT:**

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Location: Campus Santé Timone, Marseille

Duration: 6 months

Dates :

Level : Master 2

Internship profile : Research