Bioaccessibility and digestibility of lipids from food

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Introduction

Although evidence exists on the health benefits associated with the inclusion of certain lipid-rich foods (e.g. nuts, dairy products and fish) in the diet, the mechanisms that explain the physiological effects and the long-term benefits are not well understood. Lipids in themselves are essential nutrients and have many beneficial health effects: they are a source of energy and essential fatty acids, they are structural components of cell membranes, they are required to solubilise fat soluble compounds, and they serve as precursors of hormones. In general, it is only when dietary lipids are consumed in excess that they begin to have a negative impact on our health. The nutritional quality of our diet has a huge influence on our health and well-being, with a plethora of conditions and diseases being associated with a poor diet. It is becoming increasingly apparent that the nutritional quality of our food is a consequence of not only its nutritional composition but also how its structure influences the rate and extent of nutrient availability. The structure of a food influences the way it is transformed during processing and digestion. This, in turn, has an impact on nutrient bioaccessibility (release) and digestibility, and subsequently on the physiological response and health of the individual who consumes that food. Hence, care needs to be taken when assessing nutritional quality based purely on nutrient composition.

Lipids are generally insoluble in water; therefore, to be digested, lipids are required to be dispersed or emulsified to make them more accessible to the lipases which hydrolyse them into components suitable for absorption, for instance, by being released from the food matrix (from the cells of a plant tissue). The rate and extent of lipid digestion is governed by the way lipids are "presented" to the lipases in the different compartments of the gastrointestinal tract. Lipid digestion can be viewed as a colloidal and interfacial phenomenon where digestive agents (e.g. bile salts and lipases) and food components (e.g. dietary fibres, proteins and phytosterols) interact with the lipid at the lipid–water interface and thereby impact their hydrolysis by lipase(s).

Diets containing foods high in fat are considered to be detrimental to health; however, studies have shown that the consumption of certain foods which are high in fat, such as nuts and certain dairy products, led to beneficial effects on risk factors

for cardiovascular disease. A great proportion of lipid in some food matrices, such as almonds, remains undisturbed after mastication and the subsequent digestion processes. Here, the plant cell walls are resistant to digestion in the upper gastrointestinal tract and therefore encapsulate intracellular nutrients, thereby limiting lipid bioaccessibility. In dairy products, the structure of the food matrix can also have an impact on lipid digestibility. Indeed, the composition, microstructure and rheological properties of cheese matrices have been shown to impact the kinetics of the degradation of the cheese and the digestibility of the lipid it contained. Regarding food products where the lipids are readily available, such as milk and plant-based beverages or soups, other parameters can dictate lipid digestibility. These include the size of the droplets and the "quality" of the droplets interface (i.e. surface-active molecules) and the presence of certain compounds that may inhibit lipase activity (e.g. dietary fibres).

Therefore, the overall structure of the food containing the lipids is likely to also play a crucial role, notably by influencing their bioaccessibility and digestibility and ultimately their impact on nutrition and health.

This book aims to cover some of the latest research performed on food structure in the context of lipid digestion. The subjects include lipases, in vitro and in vivo models used to monitor lipid digestion, physiological aspects of lipid digestion and the impact of food structure (plant and animal sources of lipids).