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Matrix impact on the bioaccessibility of plant polyphenols in the gastric tract

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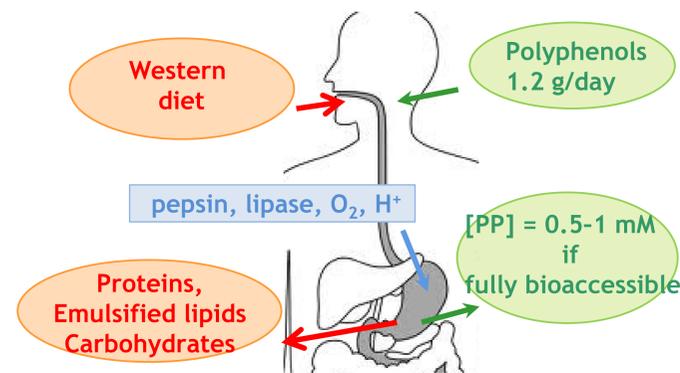
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Introduction

The consumption of fruit and vegetables (F&V) is inversely associated to the development of cardiovascular diseases, several kinds of cancers and other chronic diseases [1,2]. Moreover, the cardiovascular protection could be ascribed to flavonoids, a class of polyphenols largely distributed in F&V [3]. Polyphenols are poorly absorbed from the gastrointestinal tract (GIT) and undergo extensive metabolism by colon microflora before reaching plasma. Thus, before their absorption, polyphenols could exert a health benefit directly in the GIT. As a matter of fact, they were shown to protect polyunsaturated lipids from oxidation during gastric digestion [4]. The bioaccessibility of polyphenols, defined as their release from the food matrix and solubilization into the bolus, is a prerequisite step [5].

Objectives : This study aims at assessing the bioaccessibility of polyphenols in the gastric tract after the ingestion of either F&V or the corresponding polyphenol extract.



Materials & Methods

Animals and Test meals

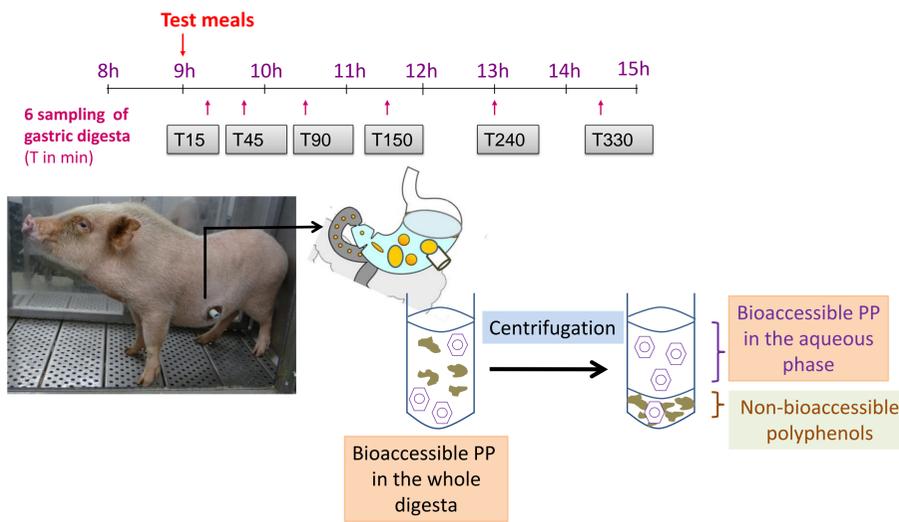
Six female Göttingen minipigs (20-25 kg) were surgically fitted with a cannula on the greater curvature of the stomach. The fasted minipigs were fed two different meals containing principally sunflower oil, cooked ground beef meat and egg phospholipids (= Beef meal).

F&V Meal

Beef meal + F&V

PP Meal

Beef meal + PP extract

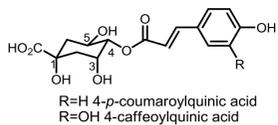
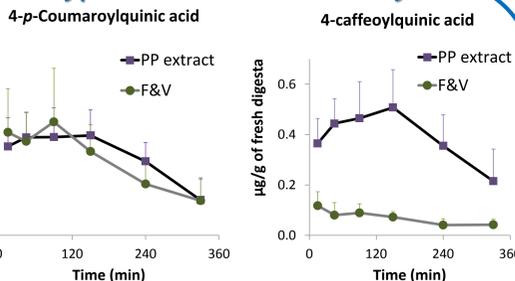


Analyses

- ✓ Polyphenols in F&V, the corresponding polyphenol extract (PP extract) and in the aqueous phase of the gastric digesta: An additional acetone precipitation /centrifugation step was conducted to evaluate bioaccessible PP in the aqueous phase. Based on known amounts of aqueous phase and precipitate, bioaccessible PP in the whole digesta could be calculated. UPLC/MSⁿ (negative ES): standards were 3,5-dicaffeoylquinic acid, 3-, 4-, 5-caffeoylquinic acids, phloretin-2'-Glc, catechin, and rutin.
- ✓ Statistics : Data are means ± EC.

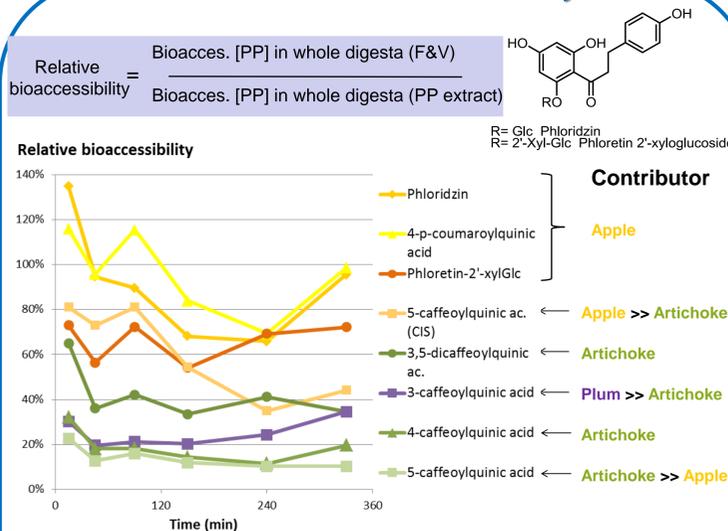
Results & Discussion

Polyphenol bioaccessibility



- ✓ Two different patterns are mainly evidenced as shown for structurally-related 4-p-coumaroyl- and 4-caffeoylquinic acids :
 - the bioaccessibilities for polyphenols provided by F&V and the corresponding extract are mostly similar.
 - Polyphenols are more bioaccessible after the consumption of the extract compared to F&V.
- ✓ Polyphenol levels in the gastric tract remain stable or slightly increase during the first 150 min before decreasing (PP extract). They tend to continuously decrease for F&V.

Matrix effect on bioaccessibility



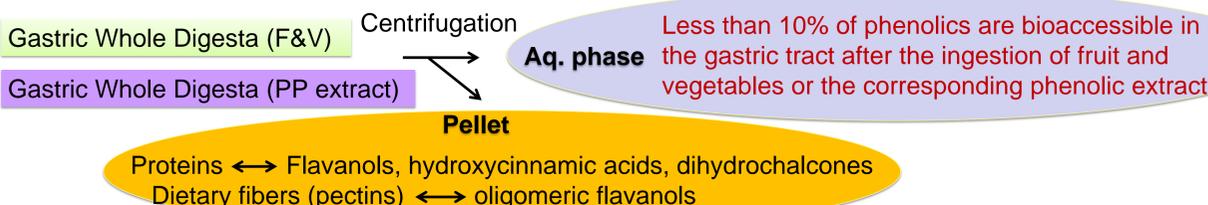
- A matrix effect on polyphenol bioaccessibility is outlined:
- Apple phenolics appear more bioaccessible after the F&V consumption (40-100% of the bioaccessibilities after extract ingestion) compared to artichoke and plum phenolics.
 - Artichoke and plum matrices limit polyphenol diffusion from plant tissues into the gastric media. Physical and chemical processes are not efficient enough to produce a total degradation of cell walls and organites.

Recovery of bioaccessible polyphenols

Hydroxycinnamic acids/dihydrochalcones/Flavanols	Recovery at 15 min in the whole digesta from F&V (%)	Recovery at 15 min in the whole digesta from PP extract (%)	Contributor
3-caffeoylquinic acid	2.6	6.9	Plum >> Artichoke
4-caffeoylquinic acid	2.2	5.4	Artichoke
5-caffeoylquinic acid	1.6	5.5	Artichoke >> Apple
5-caffeoylquinic acid (CIS)	2.9	2.9	Apple >> Artichoke
4-p-coumaroylquinic acid	9.4	6.5	Apple
3,5-dicaffeoylquinic acid	0.49	0.60	Artichoke
1,5-dicaffeoylquinic acid	0.86	0.90	Artichoke
Phloretin-2'-Glc	4.2	2.5	Apple
Phloretin-2'-Xyl-Glc	3.8	4.1	Apple
Catechin	Absence	Traces	Apple>>Plum
Epicatechin	Absence	Traces	Apple
Dimer B1	Absence to traces	Traces	Apple>>Plum
Dimer B2	Absence	Absence	Apple

- ✓ The recovery of bioaccessible polyphenols is evaluated at T15 min with the assumption of no dilution by the gastric juice. The recovery level may thus be underestimated.
- ✓ Less than 10% of the hydroxycinnamic acids and dihydrochalcones are recovered after either F&V or PP extract consumptions while flavanol monomers and dimers were not recovered.
- ➔ Most polyphenols interact with proteins and fibers and are lost upon centrifugation of the gastric digesta.

Conclusion



References

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