Health-promoting properties of food bioactives: the case study of quercetin. Preliminary results.

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Background

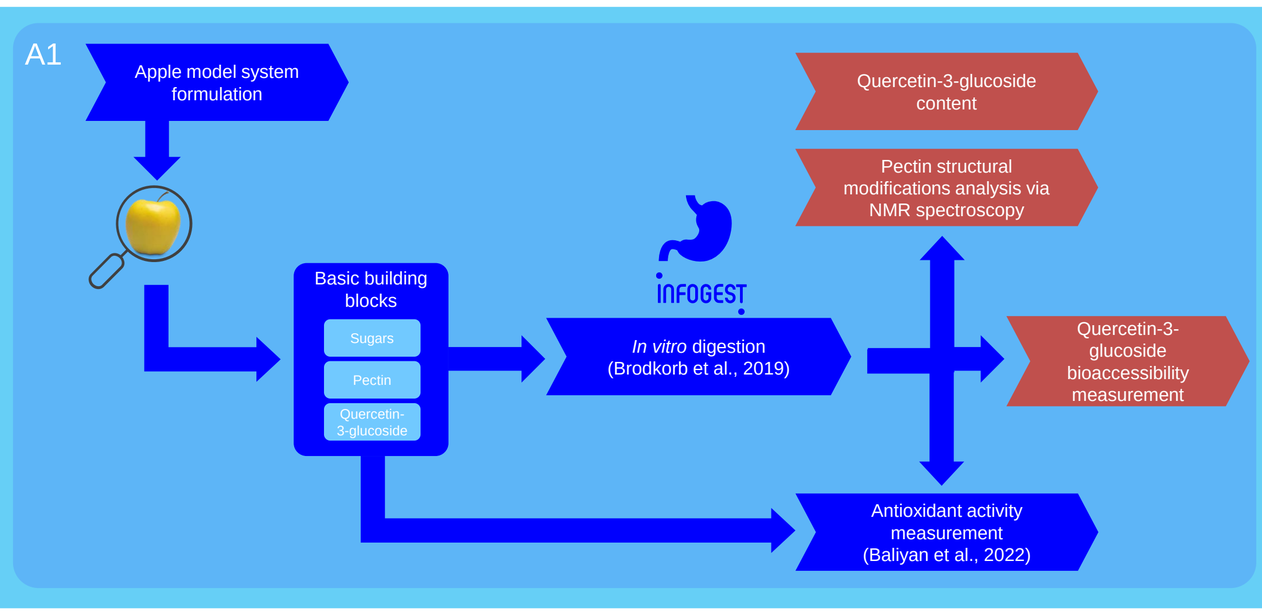
Quercetin-3-glucoside is a known bioactive compound that can be found in several fruits and vegetables, it's recognized to exert a number of beneficial effects such as antioxidant, anti-inflammatory, and antihyperglycemic activities. Although all these effects have been repeatedly reported, literature results on quercetin's physiological effects sound still controversial and the mechanisms by which it exerts these functions, especially when it is assumed with the diet, are far from being elucidated (D'Archivio et al., 2010). It is a matter of fact that quercetin activity is likely to be affected by the interactions among food components occurring before and during the digestion process (Alongi et al., 2023).

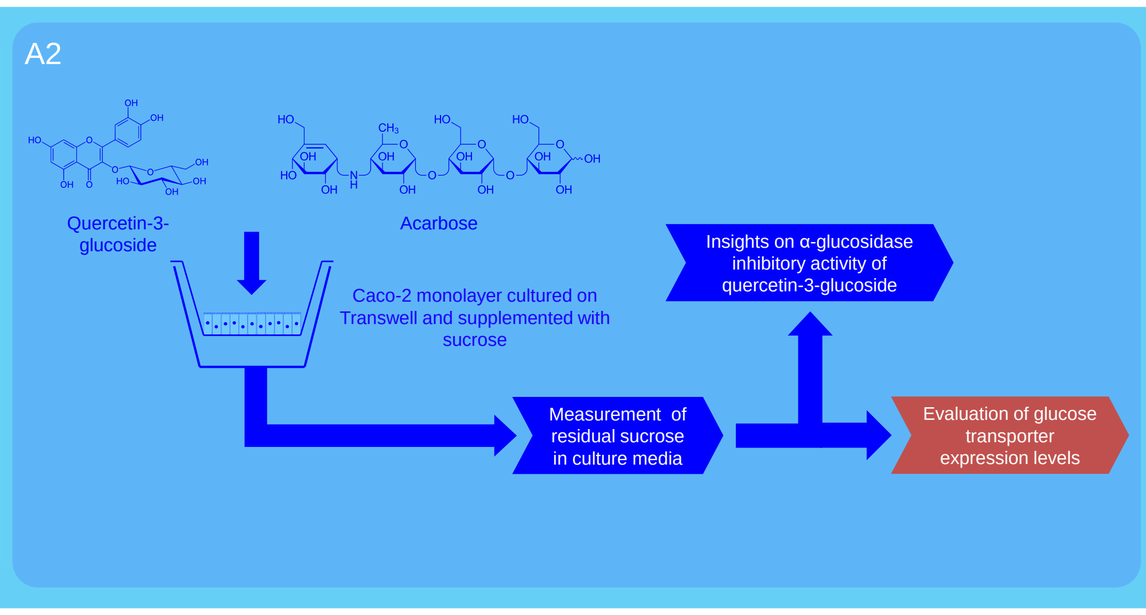
Aims

A1) Understanding the effect of the digestive process on the antioxidant activity of quercetin-3-glucoside when contained in a model system mimicking an apple.

A2) Elucidating the ability of quercetin-3-glucoside to regulate glucose absorption mechanisms at intestinal level by using Caco-2 cell lines.

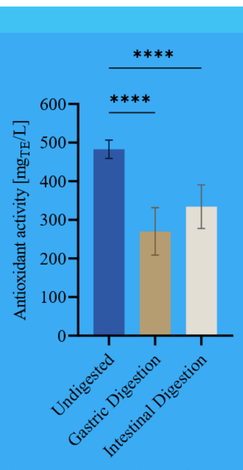
Experimental approach



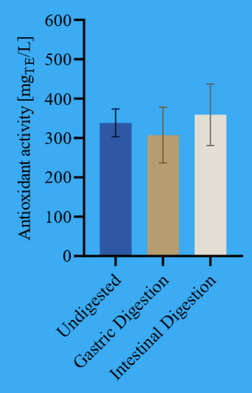


Results

A1

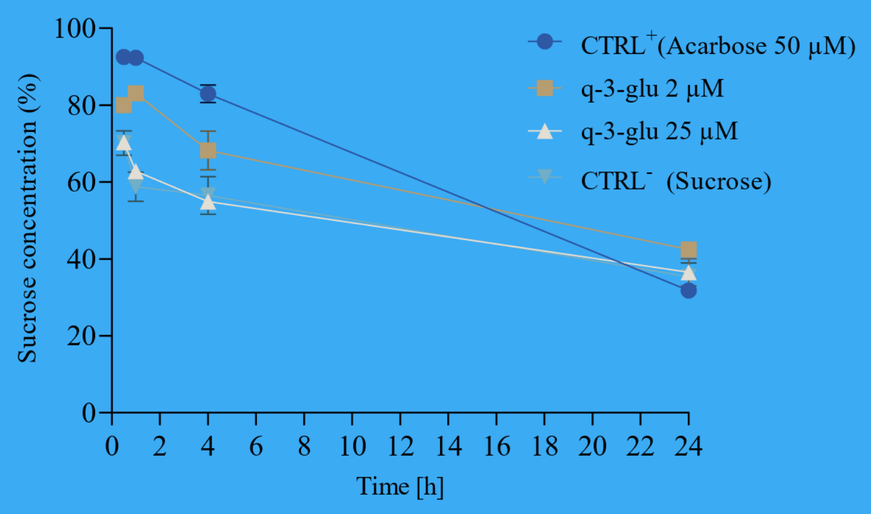


A1.1: antioxidant activity of apple model containing quercetin-3-glucoside in sugars solution (results expressed in mean ± SD, one-way ANOVA, * P ≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001, **** P ≤ 0.0001).



A1.2: antioxidant activity of apple model containing quercetin-3-glucoside in sugars solution in the presence of pectin (results expressed in mean ± SD, one-way ANOVA, * P ≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001, **** P ≤ 0.0001).

A2



Discussion

A1 The gastric process seems responsible for a loss of about 45% of the original antioxidant properties. No significant changes were further detected as a consequence of the intestinal digestion (A1.1). When pectin was present, a lower antioxidant activity was measured before *in vitro* digestion. It is likely that pectin generated a network able to embed quercetin, thus reducing its reactivity towards DPPH in the undigested sample. Conversely, the presence of pectin did not affect the antioxidant activity in digested samples (A1.2). **These results suggest that the gastrointestinal events modify the pectin shell, allowing quercetin to exert its bioactivity.** ***Trials are in progress to assess quercetin concentration after the digestion process and elucidate the fate of pectin during digestion via NMR spectroscopy in order to confirm this hypothesis.***

A2 The graph shows the percentage of residual sucrose in the culture media of Caco-2 cells treated with different concentrations of quercetin-3-glucoside (q-3-glu). Acarbose, which is a known α-glucosidase inhibitor, an enzyme involved in the release of glucose from complex polysaccharides, was used as positive control. The higher amount of residual sucrose in the culture media observed for the sample containing q-3-glu 2 µM suggests the ability of quercetin in reducing sucrose enzymatic hydrolysis. **This trend is similar to that observed with acarbose suggesting the possible role of quercetin in controlling glucose adsorption mechanisms at a cellular level. Sample containing q-3-glu 25 µM showed a negligible effect, suggesting that quercetin could inhibit α-glucosidase only in a given concentration range (Alongi et al., 2018).** ***Trials are in progress to elucidate if quercetin-3-glucoside has an effect on glucose transporter expression in Caco-2 cells cultures.***

References

- Alongi, M. et al. (2023) 'The impact of apple destructuring and thermal treatment on bioactive compounds: the fate of dietary fibre and polyphenols in puree and homogenate', International Journal of Food Science & Technology, 58(6), pp. 3189–3200.
- Alongi, M., Verardo, G., Gorassini, A., & Anese, M. (2018). Effect of pasteurization on in vitro α-glucosidase inhibitory activity of apple juice. Lwt, 98(August), 366–371.
- Baliyan, S., Mukherjee, R., Priyadarshini, A., Vibhuti, A., Gupta, A., Pandey, R. P., & Chang, C. M. (2022). Determination of Antioxidants by DPPH Radical Scavenging Activity and Quantitative Phytochemical Analysis of Ficus religiosa. Molecules, 27(4).
- Brodkorb, A. et al. (2019) 'INFOGEST static in vitro simulation of gastrointestinal food digestion', Nature Protocols, 14(4), pp. 991–1014.
- D'Archivio, M. et al. (2010) 'Bioavailability of the polyphenols: Status and controversies', International Journal of Molecular Sciences, 11(4), pp. 1321–1342.

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