

Oral and gastrointestinal bioaccessibility of anthocyanins in fresh, frozen, and blended blueberries

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Different food processing strategies could disrupt the cellular barriers of plant tissues, thus promoting the bioaccessibility (release) of plant bioactives during digestion⁽¹⁾. However, there is a lack of understanding of oral and gastrointestinal bioaccessibility of blueberry anthocyanins, and the impact of different food processing strategies on anthocyanin release.

The aims of this study were to determine: ⁽¹⁾ the extent of anthocyanin bioaccessibility in blueberries following mastication and gastrointestinal digestion; and ⁽²⁾ the impact of different processing strategies on anthocyanin bioaccessibility.

Bioaccessibility of blueberry anthocyanins was evaluated in three commonly consumed forms: fresh, frozen-thawed and a smoothie. *In vivo* mastication of both fresh and frozen-thawed blueberries, performed by 3 healthy participants (Ethics Committee Reference: HR/DP-20/21-23191), was compared to the *in vitro* simulated oral phase of the INFOGEST protocol⁽²⁾. Fresh human chewed (*FHC*), fresh simulated chewed (*FSC*), frozen-thawed human chewed (*FTHC*), frozen-thawed simulated chewed (*FTSC*) and blueberry smoothie (*BS*) samples were further digested using the INFOGEST gastric and duodenal phases. Anthocyanin contents in samples were determined by UPLC-MS/MS, presented as mg per g of fresh weight (*fw*). Anthocyanin bioaccessibility was calculated as the free anthocyanin content as a percentage (%) of the total content of blueberries. Overall, 55 types of anthocyanins were found in blueberry samples. Oral bioaccessibility accounted for <10% of the total anthocyanin released in all samples. Anthocyanin release in simulated mastication ($5.96 \pm 0.48\%$ for *FSC* and $7.97 \pm 0.19\%$ for *FTSC*) was significantly higher than *in vivo* mastication ($1.95 \pm 0.17\%$ for *FHC* and $5.03 \pm 0.09\%$ for *FTHC*, $p < 0.05$). Frozen-thawed samples had significantly higher anthocyanin oral bioaccessibility than fresh samples ($p < 0.05$). Compared with mastication, blending for making a smoothie released $8.44 \pm 0.31\%$ anthocyanins in the *BS* sample with a content of 0.196 ± 0.007 mg/g *fw*, significantly higher than the other samples ($p < 0.05$). Anthocyanin bioaccessibility following gastric digestion was higher than the oral phase for all samples ($p < 0.05$), with *BS* showing $54.79 \pm 1.10\%$ release (1.273 ± 0.026 mg/g *fw*), followed by *FTSC* ($52.41 \pm 2.20\%$), *FTHC* ($37.45 \pm 0.73\%$), *FSC* ($28.71 \pm 0.60\%$) and *FHC* ($19.63 \pm 0.43\%$). After duodenal digestion, anthocyanin recoveries were reduced for all samples ($4.67 \pm 0.01\%$ for *FHC*; $6.19 \pm 0.13\%$ for *FSC*; $4.98 \pm 0.14\%$ for *FTHC*; $5.63 \pm 0.04\%$ for *FTSC*; and $9.05 \pm 0.13\%$ for *BS*). This reduction is likely due to the higher pH environment in the duodenal phase relative to the gastric environment. In conclusion, blueberries consumed as a smoothie had significantly higher anthocyanin bioaccessibility than frozen-thawed samples, which were higher than fresh blueberries. This difference between samples is consistent with likely changes in the food matrix structure following blending and freezing. Importantly, simulated mastication leads to higher release of anthocyanins than *in vivo* mastication, so results from *in vitro* mastication should be interpreted with caution.

Acknowledgments

The research is supported by the joint PhD scholarship programme of King's College London and China Scholarship Council (K-CSC) to Zicheng Zhang.

References

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