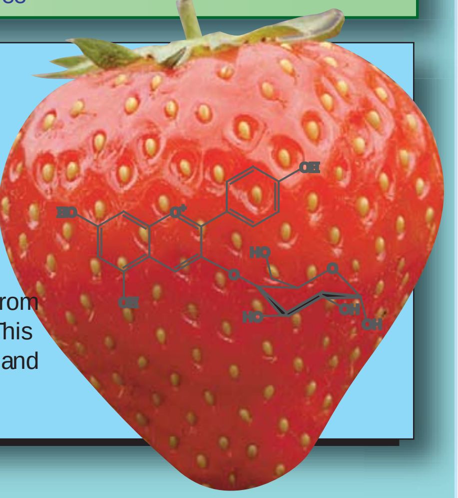
Assessing gastrointestinal stability of strawberry polyphenols using simulated gastrointestinal digestion

Malcolm Hutchison, HARRIS ACADEMY, DUNDEE

Scottish Crop Research Institute

Placement at Quality Health And Nutrition Department, Scottish Crop Research Institute, Invergowrie, Dundee

Introduction



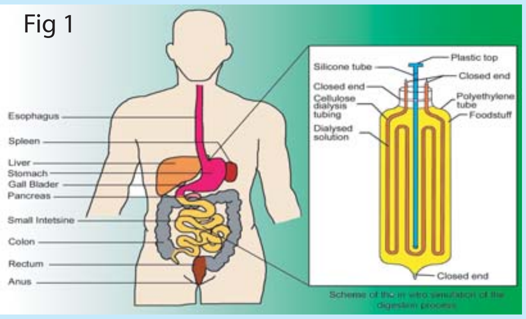
There is convincing epidemiological evidence that insufficient intake of fruit and vegetables may predispose to a range of chronic health disorders including cancers and cardiovascular disease (1). This protective effect probably has many causes but it may be related to the intake of elevated levels of natural antioxidants. Berries are a rich source of antioxidants especially polyphenols (2) which may protect against damage caused by oxygen free radicals generated through oxidative metabolism. Intake of strawberries has a range of beneficial effects from inhibition of cancers to alleviation of neuro-degeneration (3). Beneficial effects have been allocated to individual classes of polyphenols based on *in vitro* or model studies. However, for these antioxidant polyphenols to be effective they must be bioavailable i.e. absorbed from food and transported to their site of action in the body in sufficient quantity to cause their proposed effect. This study assess the stability of classes of strawberry polyphenols to simulated human gastrointestinal digestion and monitors the stability of individual polyphenols from strawberries as juice and as "chewed" berries.

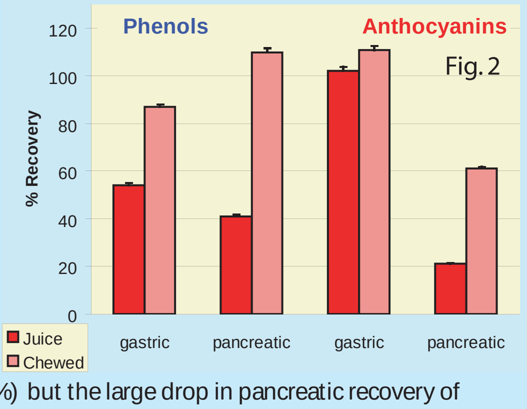
Results

Stability in Chewed vs. Juiced strawberries

The stability of phenols and anthocyanins from juiced and "chewed" strawberries was assessed using a model system (4) that mimicked the digestive processes of the human gut (Fig. 1). Considerably more phenols (Fig. 2) were recovered after gastric digestion of the chewed berries than the juiced sample (85 % c.f. 50 %.) Also the recovery of phenols after pancreatic or intestinal digestion was also much higher in the chewed samples.

Fig 1





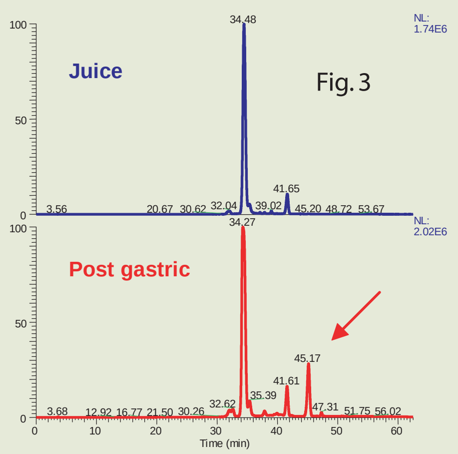
Anthocyanin recovery was similar in the post gastric samples (> 100%) but the large drop in pancreatic recovery of anthocyanins in the juice samples was avoided in the chewed samples. High performance liquid chromatography-mass spectrometry (LC-MS) revealed that recovery of the major anthocyanin, pelargonidin-3-*O*-glucoside, followed the pattern of the bulk anthocyanins with low recovery in the juice pancreatic sample (0.3%) compared to 53.3% recovery in the chewed pancreatic sample. The post-gastric samples contained an anthocyanin (Fig. 3, pelargonidin-3-O-acetylglucoside) which was not present in the original juice or chewed samples.

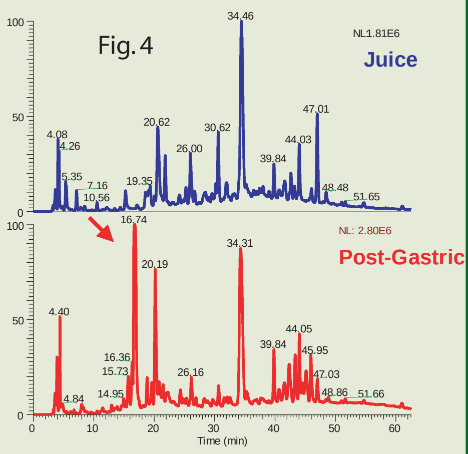
Stability of individual polyphenol components

This acetylated anthocyanin may bind to insoluble material in the juiced and chewed samples and then released in the acidic gastric conditions.

The gastric digestion also produced a novel peak (Fig. 4, arrow) that had not been previously identified in strawberries.

This compound was produced rapidly apon acidification of the samples and was a major portion of the polyphenol component of the post gastric sample. Unfortunately, it could not be unambigously identified as it did not readily ionise in either negative or positive mass spectrometric modes. Initial attempts to purify this novel component were also unsuccessful.





Discussion and Conclusions

The form in which strawberries are eaten may influence their yield of potentially bioactive polyphenols. A greater proportion of polyphenols was recovered after in vitro digestion of chewed whole strawberries than from strawberry juice. The greater recovery was reflected in the recovery of individual anthocyanins such as pelargonidin-3-O-glucoside and other polyphenols such as ellagitannins. The increased recovery may arise because the breakdown of soluble polyphenols is balanced by the continuing release of polyphenols from the berry matrix during digestion. The appearance of pelargonidin acetylglucoside during the gastric digestion suggests that this anthocyanin, which has been noted in previous extracts, may not be freely soluble under normal physiological conditions. The identification of the novel polyphenol in the post-gastric samples will require futher work. However, that this major component has not been identified previously reminds us that the release and stability of these potentially bioactive components as strawberries are eaten is not fully understood.

References

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