Could resistant starch be the redeemer of dietary carbohydrate?

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Managing postprandial glycaemia is perhaps the Holy Grail against the background of a Western diet typically consisting of over 50% carbohydrate. When we consider carbohydrate we of course think only of the starch component, and quantitatively starch is the most important, but it is becoming increasingly evident that not all starches are created equal and so cannot simply be categorised as a single ‘nutrient’. In simple terms, dietary starch is a glucan, or a chain of D-glucose monomers linked by glycosidic bonds which when digested by intestinal amylases liberate glucose which can be rapidly absorbed. In vitro, starches can be classified as either rapidly digestible (RDS), slowly digestible (SDS) or resistant (RS) and translational work has shown that this classification is useful in predicting the glycaemic excursion following ingestion.1 The relative proportions of RDS and SDS are key in determining the glycaemic index (GI) of a starchy food and GI may be a useful tool for diabetes self-management.2

So where does RS fit in? RS are starches which are resistant to small bowel enzymatic digestion and so do not result in a blood glucose response when eaten and thus are considered to be ‘unavailable carbohydrates’, fulfilling the criteria for inclusion as a dietary fibre.3 Starches can be resistant due to encapsulation such as within wholegrains and seeds (Type I), due to the native starch granule or the inherent amylase:amylpectin as with green banana or corn (Type II), due to retrogradation or food processing in cooked and cooled starches (Type III), or following cross-linking or other modification (Type IV). Each of these starch subtypes would be classified as a non-viscous dietary fibre and would exert health benefits as demonstrated with other dietary fibres in the diet in terms of glycaemic control.4 Due to the effects of ripening and food processing, it has traditionally been difficult to estimate the true intakes of RS within the UK and becomes an added issue for food labelling. The energy value of RS is attributed to the microbial fermentation of the starch and subsequent energy derived from the absorption of the microbial by-products.

How might RS impact on postprandial glycaemia?

There is sufficient evidence for a reduction in postprandial glycaemia, when RS replaces available starch, that a health claim was approved by the European Food Safety Authority in 2011.5 This is perhaps intuitive, as a glucose releasing carbohydrate is being replaced by a non-glucose releasing one. Despite this health claim, there has been very little translation within UK health care or food industry sectors. Using RS-enriched flours within food manufacture and food processing has the potential to have an impact on blood glucose management. Traditionally, it has been considered that ‘white’ carbohydrates need to be replaced with ‘brown’ alternatives, of which there is often considerable resistance to consumption. The use of RS allows the production of white high-fibre foods with a reduced glycaemic impact. Independent from this commercial aspect, is the potential to create RS during home food processing. It has been known for some time that the domestic cooking of starch has an impact on the formation of RS due to a process known as retrogradation, with common food preparation methods such as refrigeration, freezing and reheating all thought to play a part in increasing RS, as was recently demonstrated in the media.6 So it may become vital not only to know how food was processed prior to purchase, but also to have information on the most beneficial way of home preparation in order to increase RS content of foods and so reduce glycaemic impact. The true potential of this has yet to be investigated or realised fully for patients with type 2 diabetes.

Implications of long-term consumption

As a dietary fibre, the consumption of RS has long-term health implications beyond the immediate effects on blood glucose. RS is fermented by the colonic microbiota resulting in the production and release of short-chain fatty acids which have the potential to impact on both gastrointestinal and peripheral metabolism as ligands for the FFA R2/3 G-protein-coupled receptor. Chronic RS intake has been found to improve peripheral insulin sensitivity in both adipose tissue and skeletal muscle, to change gene regulation in pathways linked to fatty acid metabolism, to enhance first-phase insulin secretion, and to increase fat oxidation and reduce appetite.7

There has, however, been very little research on the efficacy of RS intake in type 2 diabetes8,9 and, as such, RS does not feature in any of the current dietary guidelines for glycaemic management. In the future there is a huge potential for translation of expansive animal data and work in those with metabolic syndrome/insulin resistance, but due to the heterogenous nature of type 2 diabetes, a very large sample size would be anticipated. However, due to current discrepancies with dietary fibre classification and labelling between the UK and the EC, with RS quantities in food changing due to ripening, cooking and processing, epidemiological approaches and the use of existing UK databases such as the National Diet and Nutrition Survey are unlikely to be informative.

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Declaration of interests

There are no conflicts of interest declared.

References

References are available in Practical Diabetes online at www.practicaldiabetes.com.
References
5. European Food Safety Authority Panel on Dietetic Products. Scientific Opinion on the substantiation of health claims related to resistant starch and reduction of postprandial glycaemic responses (ID 681), ‘digestive health benefits’ (ID 682) and ‘favours a normal colon metabolism’ (ID 783) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. EFSA J 2011;9:2024.
6. Can my leftovers be healthier than the original meal? Trust Me I’m a Doctor. BBC, October 2014.