

Concurrent Session 4: Resistant Starch

Controlling starch digestibility for human health

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Rationale – Diet and life-style related illnesses are the major causes of disability and premature death in affluent westernised countries and are emerging also in countries in the Asian region with increasing affluence. Illnesses such as coronary heart disease, certain cancers (eg large bowel) and diabetes are a consequence of the ready availability of energy-dense, readily digestible, highly refined foods. Dietary change through altered purchasing practice is an effective means of risk reduction and modifying the carbohydrate content of foods is an important route to achieving this.

Background – Humans possess one intestinal polysaccharidase (α -amylase) which can hydrolyse only starch. All other polysaccharides (non-starch polysaccharides, NSP; major components of dietary fibre) resist human digestion. High fibre foods are effective in controlling constipation and increased fibre consumption is thought to protect against colo-rectal cancer. While the importance of fibre is recognised, evidence is emerging that starches which are digested less efficiently by human small intestinal enzymes may be even more important. The significance of fibre arose from population studies showing that groups who ate unrefined foods had lower risk of diseases associated with the refined products consumed by affluent ones. However, it has emerged that the former have quite low fibre intakes but eat large amounts of starch and relatively small quantities of animal products (1). Further, their cooking practices favoured the generation of resistant starch (RS) through retrogradation. RS is that fraction of starch (and products of starch digestion) which escapes into the large bowel of healthy humans and retrogradation is a recrystallization of starch after gelatinisation giving more RS. RS is metabolised by the colonic microflora generating short chain fatty acids (SCFA) which promote several aspects of visceral function (2). RS is a mass term, reflecting the extent of small intestinal starch digestion. Glycaemic response (GR) applied to starch, describes measures of the rate of its small intestinal digestion. Slowing this process gives a lower glycaemic index (GI) and reduced demand for insulin and is of value in controlling diabetes. GR and RS are related but not synonymous and limiting both is of clear benefit.

Progress – Engineering starches to control their digestion is an important research target and CSIRO is developing a range of substantiated high RS/low GI products. One of these is a novel, hull-less barley cultivar (BARLEYmaxTM) which was produced by Plant Industry. It has a lower total starch content and an increased proportion of amylose and higher dietary fibre. The new barley can be incorporated readily into a range of common processed foods including breakfast cereals, bread and other bakery products. Wholegrain foods made BARLEYmaxTM have higher RS and lower GR than those made from standard wheat or barley and also raise large faecal SCFA. The latter finding supports a recent intervention showing that the combination of RS (22 g/day) and a moderate fibre intake (12g/day) resulted in improved indices of bowel health compared with NSP alone (3). High RS/low glycaemic index (GI) wheat cultivars are being developed by Food Futures Flagship and a high amylose wheat has been generated using RNA interference (RNAi) and shown to have high RS in rats (4). Other functional foods are being developed in p-Health Flagship to assist in the promotion of gut function and the prevention of colo-rectal cancer. One of these is a chemically modified starch which delivers SCFA to the large bowel. It is hoped that these products and ingredients will contribute to improved health and lowered disease risk. High throughput *in vitro* screens are also being developed to facilitate product development.

Future developments – Substantiation of the nutritional attributes of the new products is under way including establishing their benefits for gut health and cardiovascular risk factors.

References

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