# Response to draft SACN Report on Carbohydrates and Health Report
# Comments Related to Resistant Starch
# August 2014

## Effect of Resistant Starch on Post-Prandial Glycaemia

We welcome SACN recognition that resistant starch is considered as dietary fibre on the basis of its capacity to increase faecal mass. However, there is also adequate evidence for an effect of resistant starch on reducing post-prandial glycaemia which is both beneficial with higher proportions of resistant starch and biologically relevant. It is noted that only fasting blood glucose concentrations have been evaluated as a health benefit in the report and post-prandial values, which are listed by SACN as a physiological benefit, have been excluded. We are therefore of the opinion that the report should include an effect of resistant starch on post-prandial glycaemia. Please find below comments and relevant data references to support and substantiate this position:-

1. **Sections 9.35 to 9.49** discuss the effect of resistant starch on the following outcomes: energy intake, faecal weight, faecal pH and short-chain fatty acid content and faecal bacteria. The evidence for an effect of resistant starch on post-prandial glycaemia was not reviewed, despite there being numerous studies which address this research question. This omission is surprising since this evidence was recently reviewed by EFSA who concluded that **"a cause and effect relationship has been established between the consumption of resistant starch from all sources, when replacing digestible starch in baked foods, and a reduction of post-prandial glycaemic responses**."(EFSA NDA Panel 2011).

2. EFSA's conclusion was based on a review of 14 randomised controlled studies, 12 of which were published after 1990, the cut-off date used for the SACN Report (see Appendix A). The EFSA Panel noted that most of the studies reported a statistically significant decrease in post-prandial glycaemic and insulinaemic responses when resistant starch replaced digestible starch in test products such as muffins, bread and crackers. Based on the findings of a dose-response study, they concluded that significant effects on post-prandial glucoses responses were seen when 14% or more of total starch was replaced by resistant starch. This condition is certainly achievable through diets typically consumed in the UK with the use of appropriately substituted products.

3. The EFSA Panel considered that the reduction of post-prandial glycaemic responses may be a beneficial physiological effect with the proviso that post-prandial insulinaemic responses were not disproportionally increased. Further, SACN's previous position statement on Dietary Fibre included reducing post-prandial glycaemia as a beneficial physiological effect(SACN 2008) (Section 1.2, para 6). One randomised controlled trial of 20 insulin-resistant subjects has found that consumption of resistant starch for 12 weeks led to an improvement in insulin sensitivity(Johnston et al. 2010).

4. Following the grading system for judging the evidence set out in the draft SACN report, the evidence from 12 randomised controlled studies shows that there is adequate evidence of an effect of resistant starch on reducing post-prandial glycaemia which is both beneficial with higher proportions of resistant starch and biologically relevant. We can only surmise that this evidence was not considered by SACN because of the short timescale of these studies. However, post-prandial glycaemia is a physiological response to a meal and therefore studies to measure it must, by definition, be short term studies.

## References


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Appendix A: References to support effect of Resistant Starch on Post-Prandial Glycaemia

| Reference | Subjects (Gender; Age) | Number | Design | Length of inter-vention | Food vehicle (Control) | Amount RS2 | Effect on post-prandial glucose levels | Effect on glucose AUC | Effect on post-prandial insulin levels | Effect on insulin levels |
|---|---|---|---|---|---|---|---|---|---|---|
| Muir et al, 1994 | Healthy men and women<br>31 +/- 7 years | 3 men; 8 women | crossover | 2 hours | Bread<br>(control - 0% RS bread) | 2g/100g/RS | = | ↑NS | ↓NS | ↓NS |
| | | | | | | 3.2g/100gRS | ↓NS | ↓NS | ↓NS | ↓NS |
| | | | | | | 5.6g/100gRS | ↓p<0.05 | ↓p<0.05 | ↓NS | ↓p<0.01 |
| | | | | | | 6.6g/100g RS | NR | ↓NS | NR | ↓p<0.01 |
| Behall and Howe 1995 | Hyperinsulin-aemic(HI) men<br>28 – 58 years | 24 men, 14 hyperinsulin aemic | crossover | 14 weeks (test meal 3 hours) | Muffins, cookies, puddings | 30% amylose vs 70% amylose (HI) | ↓p<0.05 | ↓NS | ↓p<0.01 | ↓p<0.05 |
| | | | | | | 30% amylose vs 70% amylose (C) | ↓NS | ↓NS | ↓p<0.01 | ↓NS |
| Noakes et al, 1996 | Hypertriglyceridaemic<br>44 – 64 years | 13 men; 10 women | crossover | 4 weeks (test meal 1.75 hours) | Muffins (control – muffins 1.3g RS) | 5.8g/RS | ↓p<0.03 | ↓NS | ↓p<0.001 | ↓p<0.01 |
| Jenkins et al, 1998 | Healthy men and women<br>22 – 53 years | 12 men; 12 women | crossover | 2 weeks (test meal 2 hours) | Muffins, cereal (control – muffins 2.3g RS) | 21.5g RS | NR | = | NR | NR |
| Hoebler et al, 1999 | Healthy men and women<br>21 – 28 years | 6 men; 2 women | crossover | 4 hours | Bread, pasta | 16.5g RS | ↓p<0.05 | ↓p<0.05 | ↓p<0.05 | ↓p<0.05 |
| Behall and Hallfrisch 2002 | Healthy men and women<br>23 – 58 years | 13 men, 12 women | latin square | 3 hours | Bread<br>(control – glucose solution) | 2.0g RS | ↓p<0.03 | ↓p<0.001 | = | ↓NS |
| | | | | | | 3.8g RS | ↓p<0.03 | ↓p<0.001 | = | ↓NS |
| | | | | | | 8.2g RS | ↓p<0.03 | ↓p<0.001 | ↓NS | ↓NS |
| | | | | | | 11.5g RS | ↓p<0.03 | ↓p<0.001 | ↓p<0.05 | ↓p<0.001 |
| | | | | | | 13.4g RS | ↓p<0.03 | ↓p<0.001 | ↓p<0.05 | ↓p<0.001 |
| Higgins et al, 2004 | Healthy men and women<br>33 +/- 5 years | 7 men; 5 women | crossover | 24 hours (test meal 6 hours) | Muffins, pasta, drink, biscuit<br>C- 0% RS | 2.7% RS | = | ↑NS | = | ↑NS |
| | | | | | | 5.4% RS | = | ↑NS | = | = |
| | | | | | | 10.7% RS | = | ↑NS | = | ↑NS |

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| Behall and Scholfield 2005 | Healthy men and women 25 – 57 years | 12 men; 12 women | latin square | 3 hours | Cornchips (Control – cornchips 0g RS) | 11.9g RS | ↓p<0.001 | ↓p<0.05 | ↓p<0.001 | ↓p<0.05 |
| | | | | | Muffins (Control – muffins 0g RS) | 24.7g RS | ↓p<0.001 | ↓p<0.05 | ↓p<0.001 | ↓p<0.05 |
| Weickert et al, 2005 | Healthy women 23 +/- 2 years | 9 | crossover | 5 hours | Bread (Control – white bread) | 10.4g RS | = | ↓NS | ↑NS | ↓NS |
| Behall et al, 2006 | Overweight women 43 years | 10 normal weight; 10 overweight | latin square | 4 hours | Muffins (Control – muffin 0.9g RS) | 3.4g RS | ↓p<0.05 | ↓NS | ↓NS | ↓NS |
| | | | | | | 6.5g RS | ↓p<0.05 | ↓NS | ↓NS | ↓p<0.05 |
| Behall et al, 2006 | Overweight men 25 – 56 years | 10 normal weight; 10 overweight | latin square | 4 hours | Muffins (Control – muffin 0.1gRS) | 6.3g RS | ↓NS | ↓NS | ↓NS | = |
| | | | | | | 12.7gRS | ↓NS | ↓NS | ↓NS | = |
| Brighenti et al, 2006 | Healthy men and women 40 +/- 10 years | 8 men; 2 women | crossover | 9 hours | Cake (Control – cake 1g RS) | 13g RS | ↓p<0.05 | NR | ↓p<0.02 | NR |
| **Number of significant reductions + Number of non-significant reductions / Total number of comparisons** | | | | | | | (14 + 4)/23 | (9 + 10)/24 | (9 + 8)/23 | (10 + 8)/23 |

↓p<0.05: significant reduction in blood glucose level at at least one time-point; ↓NS: non-significant reduction in blood glucose levels; =: no difference in blood glucose levels; NR: not reported.; AUC: area under curve