RELATIONSHIP BETWEEN IN VITRO AND IN VIVO APPROACHES ON SLOW APPEARANCE RATE OF STARCH: A META-ANALYSIS

Sophie Vinoy 1, Aurélie Goux 1, Olivier Brack 2, Alexandra Meynier 1
1: Mondelez France R&D, Saclay, France; 2 Statistique Industrielle KHI2 Consulting (KSIC), Esches, France

INTRODUCTION

• Starch is one of the most important glycaemic carbohydrate (CHO) components in cereal products; specific steps during the manufacturing process influence its digestibility and then its impact on glycemic response.
• Many studies compared the physiological effects of starch-based products and showed a correlation between in vitro starch digestibility and the postprandial plasma glucose and insulin responses.

OBJECTIVES

A meta-analysis performed on 3 intervention studies evaluates the strength between Slowly Digestible Starch (SDS) content and appearance rate of exogenous carbohydrates (RaE) from cereal foods. The aim was to determine the contribution of SDS level to RaE kinetic across the postprandial period on continuous data.

METHODS / DESIGN

• 3 intervention studies were selected after systematic review using SDS (measured by Englyst method) and RaE.

<table>
<thead>
<tr>
<th>References</th>
<th>Population</th>
<th>Number of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nazare et al., 2010</td>
<td>Healthy overweight subjects (age: 20-60 yo; BMI: 25-30 kg/m²)</td>
<td>38 subjects (20 men and 18 women)</td>
</tr>
<tr>
<td>Vinoy et al., 2013</td>
<td>Healthy subjects (age: 18-40 yo; BMI: 20-25 kg/m²)</td>
<td>12 men (part 1)</td>
</tr>
<tr>
<td>Peronnet al., 2015</td>
<td>Healthy subjects (age: 19-26 yo; BMI: 20.2-24.4 kg/m²)</td>
<td>16 women</td>
</tr>
<tr>
<td>Total</td>
<td>Age: 18-60y; BMI 20-30kg/m²</td>
<td>66 (52% women)</td>
</tr>
</tbody>
</table>

• SDS Content: Cereal products contained high SDS level (12 to 21g/portion) vs. low SDS level (0 to 1g/portion).
• Test breakfasts were composed of a cereal product / milk / hot beverage and contained 380 – 450 kcal with (60% CHO, 29% Fat, 11% Proteins)
• A Partial Least Square (PLS) analysis was performed on RaE, in relation to SDS content, time and their interaction.
• The contribution to the incremental Area Under the Curve (iAUC) of RaE was calculated by dividing each 30-min period iAUC value by the iAUC value over the whole postprandial period for each study.

RESULTS

% of contribution to iAUC(RaE)

PLS analysis: the following model explains 61% of RaE contribution

\[
\text{Term} \quad \text{Estimate} \quad \text{Std Error} \quad \text{t Ratio} \quad \text{Prob>|t|}
\]

Intercept 0.137 0.005 27.83 <.0001*
Time -5.527e-5 2.48e-5 -2.42 0.0184*
SDS 7.474e-5 0.0002 0.37 0.7094
(Time-165)*(Time-165) -2.205e-6 3.8e-7 -5.80 <.0001*
(Time-165)*(SDS-10.4093) 0.00002 2.903e-6 7.34 <.0001*

Low SDS

High SDS

The predictor profiler illustrated the link between SDS content and contribution to RaE, depending on time: 2 examples

With low SDS content, the major contribution to RaE occurs before 165 min

With high SDS content, the major contribution to RaE occurs after 165 min

CONCLUSIONS

• These results demonstrates the dynamic contribution of SDS to the appearance rate of CHO during the postprandial period.
• High SDS content of cereal products included in a breakfast contributes to the late phase of the appearance rate of carbohydrates during postprandial period to reach its highest contribution between 165 and 270 minutes.
• This phenomenon reduces the challenge to plasma glucose and insulin demand which is related to metabolic disease prevention.