Metabolic effects of amino acid mixtures and whey protein in healthy subjects

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Background
In recent years the awareness of the insulinotrophic effects of milk has been growing. The key mechanism seems to be related to the milk proteins. In previous work, we found that whey proteins are particularly insulinotrophic compared with other proteins of animal (cod and cheese) and vegetable (gluten) origin. It was suggested that postprandial increments in certain amino acids are important in milk induced hyperinsulinaemia. Although the amino acid content of food proteins may be similar, their insulinaemic features can differ substantially. We hypothesized that not only the rate whereby certain amino acids are released during digestion is important to the insulinotrophic properties, but also the postprandial pattern of amino acids in plasma.

Materials and Methods
The postprandial amino acid pattern seen after whey ingestion was mimicked by drinks containing leucine, isoleucine, valine, lysine and threonine in proportions simulating those appearing in postprandial plasma after whey ingestion, and in amounts simulating contents in the corresponding whey meal (Table 1). A reference drink containing pure glucose was also included as well as a whey protein drink. All drinks contained 25 g of glucose. Twelve healthy volunteers aged 20-30 y participated in the study.

Results
The test drink with the branched chained amino acids, isoleucine, leucine and valine, resulted in significantly higher insulin responses (+60 %, P<0.05) compared with the glucose reference. The plasma amino acid pattern seen after the whey meal was well mimicked by a drink containing glucose and leucine, isoleucine, valine, lysine and threonine (Figure 1). In addition, this drink also mimicked the glycaemic (Figure 2) and insulinaemic (Figure 3) responses seen after the whey drink. For this drink, the glucose AUC was reduced with 44 % (P<0.05) and the insulin AUC was increased with 31 % (non significant) compared with the reference. Concerning the whey meal, the AUCs were -56% (glucose, P<0.05) and +60 % (insulin, P<0.05), respectively, compared with the reference.

Table 1 – Nutrient composition of the test drinks (g)

<table>
<thead>
<tr>
<th>Drink</th>
<th>Glucose</th>
<th>Leu</th>
<th>Ile</th>
<th>Val</th>
<th>Lys</th>
<th>Thr</th>
<th>Whey protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AA2</td>
<td>25</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.6</td>
<td>1.4</td>
<td>-</td>
</tr>
<tr>
<td>AA3</td>
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<td>2.2</td>
<td>1.1</td>
<td>1.1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AA5</td>
<td>25</td>
<td>2.2</td>
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<td>1.1</td>
<td>1.6</td>
<td>1.4</td>
<td>-</td>
</tr>
<tr>
<td>Whey</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
</tbody>
</table>

Conclusions
• The present data suggest a mechanism whereby milk induce a comparatively high insulinaemia and a low glucose response.
• The postprandial plasma amino acid pattern following whey intake may be mimicked by a mixture of specific amino acids.
• The increase of specific amino acids in postprandial plasma is the key mechanism for the protein induced hyperinsulinaemia seen after whey protein. The use of whey as an insulin secretagogue was recently tested in type 2 diabetes and found to facilitate glycaemic regulation (Frid et al, 2005).

Aim
Elucidate the mechanism of milk induced hyperinsulinaemia by evaluating the impact of specific amino acids on the postprandial insulin response in healthy subjects.

Figure 1 – Postprandial plasma amino acid responses (AUC 0-45 min)

Figure 2 – Postprandial blood glucose responses (AUC 0-90 min)

Figure 3 – Postprandial serum insulin responses (AUC 0-90 min)