A casein-based diet leads to a better bone status than a soy protein-based diet during moderate protein restriction in growing mice

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Background

The peak bone mass reached during childhood and adolescence strongly influences bone status in old age. An optimal bone acquisition during growth can be perceived as a mean to reduce fracture risk in later life. In animal models, it has been shown that insufficient protein intake during early stages of life leads to growth retardation and poor bone quality.

Our aim was to compare the effects of a casein-based diet and a soy-based diet on bone acquisition during moderate protein restriction (6% of energy intake) in a growing mouse model.

Protocol

<table>
<thead>
<tr>
<th>Group</th>
<th>Diet</th>
<th>Injection</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP-SOY</td>
<td>6% soy protein</td>
<td>PBS</td>
</tr>
<tr>
<td>LP-CAS</td>
<td>6% casein</td>
<td>PBS</td>
</tr>
<tr>
<td>NP</td>
<td>20% soy protein</td>
<td>PBS</td>
</tr>
<tr>
<td>PTH</td>
<td>6% soy protein</td>
<td>PTH 1-34</td>
</tr>
</tbody>
</table>

Results

- The LP-SOY mice had reduced bone formation rate and osteoid surface and increased medullar adiposity. There were no effect on osteoclast surface.
- The LP-SOY diet reduced bone formation and resorption markers compared to NP and LP-CAS diets.
- Bone microarchitecture:
  - Cortical bone
    - LP-SOY diet reduced cortical thickness compared to NP and LP-CAS diets.
    - PTH injection increased both cortical thickness and BMD.
  - Trabecular bone
    - NP and LP-CAS diets led to better trabecular parameters than the LP-SOY diet in the femur. PTH led to better trabecular parameters than all other groups in both femur and vertebrae.

Conclusions

- Our results show that both NP and LP-CAS diets are more suitable than LP-SOY diet to ensure an adequate bone health during growth. The LP-SOY diet is characterized by a reduction of bone formation leading to poor bone quality when compared to the NP diet or the LP-CAS diet.
- Our hypothesis is that bone formation is reduced when a critically low level is reached for one or several amino acids, which could at least partly explain the observed effects. Methionine could be the trigger amino acid as soy contains less methionine than casein.
- Our study also showed that daily PTH 1-34 injection had an anabolic effect under protein restriction (LP-SOY vs PTH)