LACPRODAN® DI-2021
– promoting calcium absorption
Calcium intake plays a major role in determining bone mass in adults and also influences the rate of bone loss associated with ageing. Due to this important contribution to building and maintaining bone mineral mass, it is vital that the bioavailability of dietary calcium is optimal.

**LACPRODAN® DI-2021 is a hydrolysate rich in bioactive peptides**

LACPRODAN® DI-2021 contains 21% casein-derived bioactive peptides, known as casein phosphopeptides (CPP). A natural part of the casein in milk, CPP are known to influence calcium absorption. The high concentration of CPP in LACPRODAN® DI-2021 makes the hydrolysate a unique ingredient for promoting calcium bioavailability.

**Bioactive peptides in LACPRODAN® DI-2021 boost calcium absorption**

The CPP in LACPRODAN® DI-2021 have a phosphorus bond via monoester linkages to seryl residues (table 1). Given their highly negatively charged structures, which arise from phosphorylation, CPP have the ability to fix nutritionally interesting divalent cations such as calcium, zinc and iron. This makes the cations stable and soluble under various physico-chemical conditions, particularly varying pH (1). Studies of CPP have documented the high capacity to form soluble complexes with calcium at lumen pH (2) and the ability to increase calcium absorption (3) from some diets.

<table>
<thead>
<tr>
<th>Casein</th>
<th>Sequence of selected phosphorylated casein regions found in bovine milk (modified from FitzGerald &amp; Meisel, 2003)</th>
</tr>
</thead>
<tbody>
<tr>
<td>αs1-Casein</td>
<td>gin-met-glu-ala-ser(P)-ile-ser(P)-ser(P)-ile-ser(P)-glu-ile-val-pro-asn-ser(P) -val-glu-gln-lys</td>
</tr>
<tr>
<td></td>
<td>pro-asn-ser(P)-val-glu-gln-lys</td>
</tr>
<tr>
<td>αs2-Casein</td>
<td>glu-his-val-ser(P)-ser(P)-glu-ile-ser(P)-glu-gln-glue-pro-ser(P)-lys-glue-asn</td>
</tr>
<tr>
<td>β-Casein</td>
<td>ile-val-glu-ser(P)-ser(P)-glu-ile-ser(P)-glu-gln-glue-pro-ser(P)-lys-glue-asn</td>
</tr>
<tr>
<td>K-casein</td>
<td>glu-ala-ser(P)-pro-glu-val-ile</td>
</tr>
</tbody>
</table>

ser(P) = serine phosphate.
Given their highly negatively charged structures, caused by phosphorylation, CPP have the ability to bind calcium and other minerals.
Using LACPRODAN® DI-2021 to increase calcium absorption

The dosage of LACPRODAN® DI-2021 necessary to enhance calcium bioavailability is related to the composition of the diet. In a rat study, the minimum dose was found to be 0.7 g CPP/kg diet to enhance calcium bioavailability from a diet with marginal calcium conditions (4). Some studies have investigated the influence of the ratio between CPP, calcium and inorganic phosphorus (Pi) on calcium absorption. An in vitro study found that the optimal relationship between CPP and calcium (Ca) was 15:1 (5) (figure 1), while another study found it to be 4:1 (6).

Our own study using in vitro digestion of calcium and CPP has shown that 19.9 mg of calcium is bound by 205 mg CPP when using our milk mineral concentrate CAPOLAC® MM0525 together with our LACPRODAN® DI-2021. This means that the recommended relationship between CPP:Calcium is 10.3:1 when using our products (7).

A study found that the relationship between calcium and Pi must be lower than 1:0.8, as a higher amount of Pi reduces calcium absorption (5). In conclusion, an optimal CPP:Ca:Pi ratio for increasing calcium absorption was proposed: 4-15:1:0.8 (table 2).

<table>
<thead>
<tr>
<th>Dosage of CPP and proposed optimal ratio of CPP:Ca:Pi (in vivo)*</th>
<th>Casein phosphopeptides</th>
<th>Calcium</th>
<th>Inorganic phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio (w/w)</td>
<td>4 to 15</td>
<td>1</td>
<td>0.8</td>
</tr>
</tbody>
</table>

A Minimum dose ~ 0.7 g/kg diet with marginal calcium conditions
B The content of CPP in LACPRODAN® DI-2021 is 21% of the product
C Depending on food matrix
D The content of calcium in CAPOLAC® MM0525 is 24% of the product

LACPRODAN® DI-2021 is a hydrolysate for use in functional foods

LACPRODAN® DI-2021 is all natural and obtained by enzymatic hydrolysis followed by debittering and concentration. The high content of bioactive peptides makes it suitable for incorporation in functional foods designed to increase calcium bioavailability.
REFERENCES


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