Abstract

Effect of calcium on iron absorption in man

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The aims of the present study were:
1. to study the effect of calcium on both heme and non-heme iron absorption.
2. to examine the mechanism of action of the observed inhibition of iron absorption by calcium, and
3. to investigate the nutritional importance of this inhibition and search for methods of overcoming the inhibition of iron absorption by calcium from the whole diet.

Absorption of non-heme iron was measured by adding a radioactive inorganic tracer to a food component or a composite meal. Heme iron absorption was measured by using biosynthetically radioiron-labelled hemoglobin as an extrinsic tag. Iron absorption from different meals and with/without the factor (i.e. calcium, phytate, ascorbic acid) to be tested was compared in the same subjects using two different radioiron isotopes to reduce the confounding effect of inter-subject variation in iron absorption.

Heme and non-heme iron are absorbed by different mechanisms. Calcium inhibited both kinds of iron to the same extent, which suggests that calcium interacts with iron within the mucosal cell. When the intake of calcium and non-heme iron was separated in time (2h and 4h), no inhibiting effect of calcium on iron absorption was seen. Iron absorption from the whole diet was studied for two 10-day periods using extrinsic tag labelling of all meals to the same specific activity, when calcium was administered either with all meals or mainly with breakfast and evening meals. Non-heme iron absorption increased by about 30-40% when calcium was moved from the main meals containing most of the dietary iron. The hypothesis tested was that the higher iron absorption from human milk vs cow's milk was due to the higher calcium content of the latter. By adding calcium to human milk to reach the same calcium content as in cow's milk, it was found that most of the difference in non-heme iron absorption was explained by the calcium content. This result is of great practical importance considering the high content of both calcium and iron in infant formulas.

The major findings are of considerable importance for iron nutrition. A calcium salt, milk or cheese strongly interferes with both heme and non-heme iron absorption. The interaction is most probably located in the mucosal cell in a transport step which is common for both heme and non-heme iron. A higher bioavailability for iron may be achieved by limiting calcium intake to the main meals which usually contain most of the dietary iron. This finding is important since the prevalence of iron deficiency is often high in age groups with high calcium requirements.

Key words: Iron absorption, heme iron, non-heme iron, man, calcium.

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