PRO1302

Iron absorption of intrinsically-labelled lentils: a human feeding trial

INVESTIGATORS

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STUDY SPONSORS

Agriculture Development Fund (SK Ministry of Agriculture)

Saskatchewan Pulse Growers

STUDY TYPE

Health Outcomes: Clinical Trial-nutrition study

OBJECTIVES

1. To assess the iron (Fe) absorption in a human model from a single test meal containing intrinsically-labelled lentil
2. To compare the bioavailability of Fe from ^{57}Fe-intrinsically labelled lentils (a non-heme source of Fe) to that observed for a reference dose of ^{58}Fe as ferrous sulfate (as iron supplement)
3. To assess associations between Fe absorption from each meal and iron status indicators

WHY STUDY NEEDED

Iron (Fe) deficiency is the most prevalent nutrient deficiency worldwide and biofortification of staple food crops such as lentils may be an effective solution. The relative Fe bioavailability in various lentil lines can be predicted using a combination *in vitro* digestion/Caco-2 cell model and *in vivo* poultry feeding model. However, human feeding trials are needed to obtain a more accurate measure of actual human bioavailability (e.g. how much Fe from a lentil food is absorbed). The results of the human feeding study will be used to develop a future human efficacy trial involving biofortified lentils.

HYPOTHESIS

Consuming iron biofortified lentils in a single meal will improve human iron status.

STUDY DESIGN

Twenty healthy female subjects (18-35 years) were recruited and were randomly assigned to receive either a single meal containing 117 g of intrinsically-labelled Fe ^{57} (a safe, naturally occurring isotope of iron) lentils (CDC Maxim) or an extrinsically-labelled ferrous sulfate

($FeSO_4$, ^{58}Fe) supplement. The lentil meal consisted of 330g of dal (lentils, onions, garlic, and spices) containing 8mg ^{57}Fe.

Anthropometric data (height, weight) was obtained and blood samples were measured for iron status indicators (hemoglobin, hematocrit, serum transferring receptor, ferritin, folate, and B_{12} concentration) at time of meal ingestion and two weeks later to determine how much iron was absorbed from lentil.

Based upon the results of blood testing on day one, six of the nineteen women in the trial were considered to be anemic.

FINDINGS

1. Iron absorption from the $FeSO_4$ (^{58}Fe) supplement was significantly higher compared to the intrinsically-labelled ^{57}Fe in the lentil meal with no effect of meal order on Fe absorption from either the supplement or the lentil meal.

2. Subjects absorbed an average of 23.56±13.22% (8.10-52.58%) Fe from the $FeSO_4$ (^{58}Fe) supplement compared with 2.24±3.44% (0.34-15.30%) from the ^{57}Fe lentil meal. Fe absorption from the $FeSO_4$ (^{58}Fe) supplement was significantly higher in anemic women compared to the non-anemic women in the trial. The difference between anemic and non-anemics was not as great for the lentil meal, although there was a trend for greater Fe absorption from the ^{57}Fe lentil meal for the anemic (4.17 ± 5.6%) compared to the non-anemic group (1.34 ±1.41%).

3. Researchers hypothesized that the cause for minimal Fe absorption from the lentil meal was most likely due to the presence of phytic acid and/or polyphenol content. It is recommended that biofortification efforts also focus on reduction of mineral chelators (phytate, polyphenols).

SIGNIFICANCE OF STUDY

Furthers body of knowledge of the bioavailability of non-heme iron sources from a staple food crop.

These findings were similar to results noted in previous human studies using, for example, sweet potato and common bean as non-heme food sources, where there was low Fe absorption with these foods.

Recommended further studies focus on biofortification to increase mineral content in staple foods and on reducing inhibitors of mineral absorption e.g. phytic acid and polyphenols.

Recognition that many factors contribute to Fe absorption in humans including the effect of other foods commonly consumed in the diet (fish, vegetables, spices etc.) and that future efficacy studies should look at both the crop and the meal in regions where iron deficiency is prevalent.

PUBLICATIONS, PRESENTATIONS, EDUCATIONAL MATERIALS PRODUCED

None.

VALUE TO PRODUCERS

Adds to body of knowledge about bioavailability of micronutrients in Saskatchewan grown lentils which could serve as a whole food source for Fe.