Human iron absorption from lentil

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SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Total Project Cost
$37,100.00	Completed	April 2013 – February 2014	$37,100.00

Project Description

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.

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 (FeSO4, 58Fe) 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 B12 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.

Outcome

1. Iron absorption from the FeSO4 (58Fe) supplement was significantly higher compared to the intrinsically labelled 57Fe 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 FeSO4 (58Fe) supplement compared with 2.24±3.44% (0.34-15.30%) from the 57Fe lentil meal. Fe absorption from the FeSO4 (58Fe) 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 57Fe lentil meal for the anemic (4.17 ± 5.6%) compared to the nonanemic 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).

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.

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

Research Objective

OBJECTIVE 1
To characterize the Fe absorption from a test meal of intrinsically-labeled 57 Fe lentils.

OBJECTIVE 2
To compare the bioavailability of Fe from 57 Fe-intrinsically-labeled lentils to that observed for a reference dose of 58Fe as ferrous sulfate.

OBJECTIVE 3
To assess associations between Fe absorption from each meal and iron status indicators.