

## Isotope aided studies of the bioavailability of iron from common diets from Peru\*

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### Abstract

The nutritional iron absorption from a typical peruvian diet was studied by the Eakins and Brown method. The food were breakfast: coffee and bread with butter; lunch: vegetable soup rice with cow tripe stew and lemonade; dinner: vegetable soup and bread. The results show that despite low iron content in the meals, which is not enough to meet daily iron requirements absorption was good in lunch possibly by the action of the promoters as corbie acid (lemonade) and heme iron (cow tripe). Iron absorption in lunch was good and different from dinner and breakfast. We cannot conclude if the low iron absorption from bread is affected by coffee.

## 1 Introduction

Iron deficiency anaemia is the most common single nutrient deficiency in the world [1-5]. Its prevalence is worldwide, although the most affected are the developing countries [2-3].

Pregnant women and small children are the high risk groups to develop iron deficiency anaemia due to their higher iron requirements [1-3]. Iron deficiency alters celular immunity and may produce an increase in morbidity due to infectious diseases [5]. It also produces a decrease in work capacity [6-8]. In children, iron deficiency affects learning capacity and results in changes in behavior [9-11]. In pregnancy, there is information that suggests that severe anemia increases the risk of maternal morbidity and mortality as well as premature delivery [3]. The control of iron deficiency has considerable potential in the improvement of maternal and child health.

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In Peru there is no programme for combating iron deficiency. Considering the importance of this nutrient in the health status of the mother and child, we were motivated to develop a programme of iron fortification as a strategy for combating anaemia. As an essential first step in this strategy, we carried out a representative population based Survey in the city of Lima ( 30 % of the national population) to measure the prevalence of iron deficiency anaemia in these risk groups.

Information on socio-economical indicators, pre-natal control and antropometry were recorded. Presently we are analysing the correlation of these variables with the level of anaemia.

In addition we obtained information on food consumption, for the selection of an appropriate food vehicle and the selection of the main meals consumed by most of the population in the city of Lima.

This information also had been useful for the demonstration of the severity of this nutritional deficiency in the country and make the local authorities aware of the problem and the necessity of developing programmes to combat anaemia. Based on food consumption data we propose to evaluate iron absorption on some common food diet from Lima.

## 2 Experimental method

Subjects: Eight non - pregnant women and five men in apparent good health ranging from 26 to 45 years old, residents in Lima participated. Written informed consent was obtained from each volunteer subject before participation. Approval was obtained from the ethical committee of the Instituto de Investigación Nutricional and from the National Atomic Energy Institute (IPEN).

Foods. Each volunteer subject consumed:

- Breakfast: coffee (1 cup 300 ml with 2,6 gr. instant coffee and 21,33 gr. brown sugar), 2 bread rolls of 27,5 gr each with 5 gr butter.
- Lunch: Vegetable soup 150 gr and 150 gr of rice with cow tripe stew. Lemonade: 200 ml, lemon juice ( 9 ml ) with 10 g of sugar.
- Dinner: Vegetable soup 417 gr, with 2 bread roll 28 gr each.
- Meals were prepared in the Institute's Kitchen according to the recipes obtained from the study.

Absorption measurements.

On day 1, A venous blood sample was obtained to determine haemoglobin then they were given an aqueous solution of ferrous sulphate 3 mg containing a 2:1 molar ratio of ascorbic acid to iron, labeled with  $^{59}\text{FeCl}_3$  1,5  $\mu\text{Ci}$  as a drink, 3 hours latter they consumed a porridge made by mixing the vegetable soup with the rice and cow tripe, labelled with 5  $\mu\text{Ci}$  of  $^{55}\text{FeCl}_3$ .

On day 14, A venous blood sample was obtained to measure the radioactivity incorporated into erythrocytes. Then they received coffee 300 ml and 2 rolls (55 gr) with butter (10 gr) labelled with 1,5  $\mu\text{Ci}$  of  $^{59}\text{FeCl}_3$ . Three hours later they ate a vegetable soup 400 gr with 2 rolls (55 g) labelled with 5  $\mu\text{Ci}$  of  $^{55}\text{FeCl}_3$ .

On day 28 a venous blood sample was taken in order to calculate the increase in radioactivity between days 14 and 28.

All test meals were eaten after 10 hours fast in the morning, only water allowed for 3 hours following the test foods.

Blood sample was analysed according with the method of Eakins and Brown. The activity of radioisotopes was analysed with a liquid scintillation counter (Tri-Carb Packard).

The percentage absorption was calculated on the assumption that 100 % of the absorbed radioactivity was present in the hemoglobin. Blood volume of each subject was calculated by sex, weight and height according to Naddler [11]

### 3 Statistical analysis

Iron absorption is expressed as percentage of the administered dose. Results are expressed in mean and standard deviation.

Comparison of absorption of a pair of diets between the same subject was done by t test.

### 4 Results

Table 1, shows the main characteristics of volunteers in the study. Table 2, showed the nutritional content of the tested foods, total iron intake is rather low than requirements.

Table 1. Characteristics of the subjects

Code	Sex	Age	Weight (kg)	Height (cm)	Hemoglobin (g/dl)
10	F	36	67	158,4	14,5
11	F	35	57	157,9	12,1
12	F	28	53,5	151,9	12,4
13	F	40	59	173,3	12,6
14	F	27	52	157,6	12,1
15	F	40	67	164,4	11,3
16	M	32	64	177,2	14,98
17	F	25	64	163,8	13,4
18	F	37	54	151,4	13,9
19	M	45	81	175,6	12,6
20	M	28	70	178,0	16,0
21	M	37	63	173,8	14,4
22	M	30	85	176,6	14,9
Mean		33,8	64,3	166,1	13,5
SD		6,0	10,0	10,0	1,4

**Table 2. Nutritional content of common peruvian meals**

MEALS	Calories	Protein g (g)	Fat g (g)	Iron mg (mg)	Ascorbic mg acid (mg)
Breakfast	317	4,7	8,21	1,1	0,6
Lunch	768	23,7	21,09	3,2	28,1
Dinner	239	10,6	5,9	1,0	4,7
<b>TOTAL</b>	<b>1324</b>	<b>39,0</b>	<b>35,2</b>	<b>5,3</b>	<b>33,4</b>

Bioavailability of iron in lunch was good and was significant different from dinner and breakfast, see Table 3. We cannot conclude if the low iron absorption from bread is affected by coffee.

**Table 3. Iron absorption from meals (% of dose)**

CODE	Ferrous	Lunch	Breakfast	Dinner
10	26,88	7,43	4,7	4,27
11	38,30	47,22	13,59	7,36
12	18,81	-	8,9	11,49
13	2,94	5,79	2,2	3,92
14	8,17	12,56	4,84	2,2
15	21,71	19,11	7,64	5,11
16	14,07	13,31	-	4,4
17	23,90	12,1	0,45	1,68
18	14,22	9,74	4,48	4,46
19	10,4	9,21	0,92	7,85
20	10,34	16,63	1,56	6,11
21	2,01	8,4	0,21	1,0
22	9,29	14,37	0,92	6,79
<b>Mean</b>	<b>15,46</b>	<b>14,66</b>	<b>4,20</b>	<b>5,13</b>
<b>SD</b>	<b>10,24</b>	<b>10,96</b>	<b>4,10</b>	<b>2,85</b>

Despite low iron content in the meals, which is not enough to meet daily iron requirements, absorption was good in lunch possibly by the action of the promoters ascorbic acid (lemonade) and heme iron (*mondonguito*). Nevertheless the total intake of iron needs to be improved through an enrichment of the basic foods with iron (Programa de fortificación).

## 5 Conclusion

1. The improvement of iron intake through an iron fortification strategy is the best approach to combat iron deficiency in Peru.
2. Total iron content of these common foods is low. Iron absorption from lunch recipes is better than other meals. However absorption can be improved by consumption of ascorbic acid and a small amount of heme iron.

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