USE OF IRON FORTIFIED FOODS IN HUMAN NUTRITION.

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SUMMARY: Hemeiron fortified foods (7-42.5 mg/100g) were supplied to different poblational groups (A:"healthy people", B:pregnant women, C:women suffering iron defficiency anemia and D: burned patients).
In group A, children, women and people older than 60 improved its hemoglobin values when they ate the fortified foods.
For groups B and C, the fortified foods could successfully substitute the usual treatment (ferrous fumarate) while in group D patients who ate the fortified foods stayed shorter at the hospital and needed less volumes of blood transfusion.

INTRODUCTION: Blood cells are not only the most valuable source of heme iron but its protein content is greater than those of meat, liver, whole blood and plasma (Wismer-Pedersen, 1988). However, its use is limited mainly because of the changes in sensory attributes in foods in wich they are added (Fernández et al, 1989).
In spite of the fact that many foods contain iron, iron deficiency is the most common nutritional deficiency in the world (De Meayer, 1985). The poor biodisponibility of the iron in common foods like rice, wheat, maize and other vegetable origin foods can explain this fact (INAGC, 1981).
The aim of this paper is to evaluate the influence of using heme iron fortified foods in the prevention and treatment of iron defficiency anemia in some risk human groups.

MATERIALS AND METHODS: Meat and flour products with the following composition, were used: protein (11 - 19 %), fat (15 - 25 %), ash (3 - 5 %), heme iron (7 - 42.5 mg/100g).
-Studies on the prevention of iron defficiency anemia.
Voluntary people (male and female) were classified in one of two groups:
People in the control group kept its usual daily food intake. The second group was supplied with the fortified heme foods for 6 months having an extra 8 iron mg/day intake.
The biochemical evaluation of iron status was done before and after of the iron fortified food supply.
For female, iron store (INACG, 1981) and the intake of meat, total iron and ascorbic acid in each meal were calculate in order to stablish the quantity of absorbed iron (Monsen et al, 1978; Monsen, 1982)
-Studies on pregnant women.
Prenant women (88) were classified in one of two groups:
Women in control group (47•) received ferrous fumarate as iron supplement,while the other (41) ate the hemeiron fortified foods as solely iron supplement.
All women were 20 - 30 years old and those women who presented any factor having possible influence on newborn' s weight or iron status were lead out of the experiment.
The biochemical evaluation of iron status was done at the moment

in which pregnancy was stablished and inmediatly after the child birth. Newborn's weight was also measured.

-Studies with women suffering iron defficiency anemia.

Iron defficiency was considered when hemoglobin (Hb) was less than 120 g/L, transferrin saturation (TS) was less than 16 % and free erythrocyte protoporphirin (FEP) was less 60 mg/100mL. Control group (25) received ferrous fumarate as iron supplement, maining 100 iron mg/day while the other (32) ate 200g of fortified food/day, maining 24 - 52.5 iron mg/day.

The biochemical evaluation of iron status was done at the beginning of the treatment and at the moment in which Hb reached 120g/L and every month after until FEP and TS reached the normal values. Mean while, Hb was measured every other week.

-Studies on burned patients.

Patients (123) were classified according to the extent of its injuries in 3 classes: less grave,grave and most grave. The control group (60) received the usual diet while the others (63) ate 200g of fortified foods/day. Hospitalary stay and volumen of blood transfusion were controlled.

-Biochemical evaluation: Hemoglobin concentration was estimated as cyanomethemoglobin, TS was computed by dividing serum iron by total Fe-binding capacity (Loira,1968) and FEP was measured fluorometrically (Piomelli,1975).

RESULTS AND DISCUSSION:

-Studies on the prevention of iron deficiency anemia.

Biochemical values of people eating heme fortified food were improved (table 1), mainly children 1 - 9 years old (A, B), women (D) and people older than 60 (F). Hemoglobin was the variable having the most important changes.

Biochemical values of the control group didn't change (table 1). However, a trend to slightly decreasing in iron stores was observed in sub-groups C (10 - 15 years) and F (> 60 years).

An important change in quantity and quality of absorved iron is due to the fortified foods (table 2). Women in this group raised their levels of absobed iron to the figure propossed by FAO/WHO (1988) to reduce the risk of developing iron deficiency anemia for menstruating women.

Table 1.- Average value of biochemical indexes at the beginning (B) and at the end (E) of the experiment

			Hb(g/L)		TS(%)		FEP(mg/100mL)	
Group	Age	Number	B	E	B	E	B	E
Test	1 - 4	22	117b	123a	18.5b	24.3a	56.9b	52.2a
	5 - 9	12	120b	127a	23.9a	24.2a	50.8b	43.8a
	10 - 14	10	130a	132a	28.6a	25.9a	51.9b	36.3a
	women	36	122b	128a	25.6a	26.5a	55.0a	50.0a
	men	16	149a	152a	34.2a	36.2a	34.2a	38.6a
	>60	26	128b	133a	32.0a	31.9a	44.2a	45.8a
Control	1 - 4	15	115a	116a	22.1a	22.3a	53.0a	52.5a
	5 - 9	14	123a	123a	26.6a	21.5a	43.4a	40.1a
	10 - 14	9	123a	120a	24.6a	23.7a	44.4a	68.8b
	women	35	123a	125a	25.5a	25.9a	45.4a	45.2a
	men	12	149a	149a	34.1a	36.6a	41.9a	45.7a
	>60	22	134a	135a	33.8a	34.0a	38.7a	44.9a

Means with different letter in the same group and the same row and the same variable differs significatively ($p<0.05$).

Table 2.-Heme, non heme and total iron absorbed (mg) by women, at the beginning (B) and during the experiment (D).

	Iron absorbed(mg)					
Group	heme		no heme		total	
	(B)	(D)	(B)	(D)	(B)	(D)
test	0.16	1.60	0.69	0.77	0.85	2.37
control	0.12	-	0.63	-	0.75	-

-Studies on pregnant women.

Women suffering iron defficiency anemia at the beginning of the experiment, presented a significative raise in Hb values, being this change greater in the experimental group than in control group (table 3). Some psychological rejection to ferrous fumarate because of the negative reactions it could produce could explain this fact.

A possible association between newborn's weight and fortified food intake was suggested because newborn's weight was greater (table 4) for the experimental group than for control group. One ofthe babies inthis later group wasclassifed as two little according to the pregnancy time. As fortified food not only supply iron but high quality protein too as well, this association could be reasonable.

Table 3.- Biochemicals values obtained in pregnant women at the beginning (B) and at the end (E) of the experiment

		Hb(g/L)		TS(%)		FEP(mg/100mL)	
Group	Number	B	E	B	E	B	E
F1	28	118a	115a	29.8a	21.5b	58.1a	93.1b
F2	13	104a	112b	15.5a	18.3a	113.0a	98.5a
C1	34	119a	117a	29.3a	24.2a	58.3a	74.4b
C2	13	103a	106a	16.0a	18.0a	69.4a	87.1b

F1 and F2 ate iron fortified foods. C1 and C2 mean control
2 mean that Hb was lesser than 110 g/L at time B
Means in the same row and variable differs significatively ($p<0.05$)

Table 4.-Newborn's weight (g)

Group	Number	Average weight
F1	28	3447ab
F2	13	3499a
C1	33	3282c
C2	13	3382b

Means in the same column with different letters differs significatively ($p<0.05$)

-Studies with women suffering iron defficiency anemia.
Women in both groups reached the reference limits stablished for all variables (table 5) not even treatment with ferrous fumarate was shorter. All people in the experimental group reported that typical symptons (apathy, irritability, impeared attentiveness and pica) of this nutritional deficiency dissapeared between 7 - 15 day after start eating the fortified foods, as it has been reported for other treatments (Crosby, 1976). 40 % of people in this group was intolerant to inorganic iron (oral or parenteral way). They reached normal biochemical values eating the fortified foods after had been suffering chronical iron defficien anemia during up to 20 years.

Table 5.- Biochemicals values obtained in the iron deficiency treatment with iron fortified foods (test) or ferrous fumarate (control) at the beginning (B) and at the end (E)

Group	Variable					
	Hb (g/L)		TS (%)		FEP (mg/100mL)	
	B	E	B	E	B	E
Test	98b	126a	8.7b	21.9a	194.7b	78.7a
Control	94b	125a	7.9b	22.6a	207.7b	62.0a

Means with different letters in the same variable and in the same row differs significatively ($p<0.05$)

-Studies on burned patients.
Burned patients in control group stayed at the hospital longer (24 days) than patients eating the fortified food (18 days). Also needs of blood transfusion were higher for patients in control group (200 mL) than for the others (130 mL). For patients classified as most grave there was not any difference between both groups.

CONCLUSIONS: The intake of iron fortified foods helps human nutrition. When some disorders appears in the iron status, they can be used to improved it, being specially usefull for people rejecting others sources of iron.

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