



# Forging Effective Strategies to Combat Iron Deficiency

**EMORY CONFERENCE  
CENTER HOTEL  
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# IRON FORTIFICATION OF FLOURS IN VENEZUELA

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In 1992 prevalence of iron deficiency and anemia in children and adolescents in the lower socioeconomic strata of Caracas population was 37% and 19 %, respectively. As a result, in 1993 the Venezuelan Government nominated a special commission for the enrichment of food (CENA), that started a program to fortify precooked corn and wheat flours with iron and vitamins.

	<b>Precooked corn flour/ Kg</b>	<b>White wheat flour/ Kg</b>
<b>Vitamin A (IU)</b>	<b>9,500</b>	<b>--</b>
<b>Thiamine (mg)</b>	<b>3.1</b>	<b>1.5</b>
<b>Riboflavin (mg)</b>	<b>2.5</b>	<b>2.0</b>
<b>Niacine (mg)</b>	<b>51.06</b>	<b>20.0</b>
<b>Iron (mg)</b>	<b>50.0*</b>	<b>20.0</b>

**\* As ferrous fumarate. Since 1994 2/3 as ferrous fumarate and 1/3 as electrolytic iron.**

During the first year of iron fortification the only adverse effect observed occurred in two regions of the country where hard water is used to prepare the corn bread the night before it is consumed. They noticed that the bread turned slightly dark the day after it was baked.

This inconvenience determined a change in iron fortification pattern and from February 1994, the precooked corn flour was enriched with 30 mg/kg of iron as ferrous fumarate and 20 mg of electrolytic iron. This pattern of iron fortification has been continued since February 1994.

FUNDACREDESA conducted yearly national surveys on children of 7, 11 and 15 years old during 1990, 1992 and 1994.

Since 1997 a new project: "Impact of flours fortification program in Venezuelan population", has conducted surveys in 1997, 1998 and 1999.

## PREVALENCE OF ANEMIA AND IRON DEFICIENCY IN CHILDREN AND ADOLESCENTS (7,11 AND 15 YEARS OLD) FROM CARACAS

YEAR	ANEMIA	IRON DEFICIENCY
	%	%
1992	19	37
1994	9	16
1997	16	13
1998	18	10
1999	17	16

**Statistical analysis of ferritin concentration in total samples (7, 11, 15 y)  
from the 1992, 1994, 1997 and 1999 surveys.**

	<b>1992</b>	<b>1994</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Mean	18.01 <sup>D</sup>	25.20 <sup>C</sup>	28.67 <sup>A,B,C</sup>	33.98 <sup>A</sup>	31.64 <sup>A,B</sup>
SE	0.82	0.86	0.74	1.26	0.89
Median	15	22	24	28	27
n	282	317	571	466	537

<sup>A-D</sup> Means with no common letters differ,  $p < 0.001$

# Wheat flour

		Iron Absorption (%)				
Subjects and Sex		A	B	C	D	E
		Basal Breakfast alone	Basal Breakfast + American coffee 2g	Basal Breakfast + Espresso coffee 4g	Basal Breakfast + Capuchino coffee 4g	Basal Breakfast + Espresso coffee 8g
Basal Breakfast with white wheat bread						
2M 8F	Mean	6.8	1.2	0.4		0.7
	SEM	1.2	1.4	1.4		1.2

Statistics: A vs. B  $p < 0.05$ , A vs. C  $p < 0.05$ , A vs. E  $p < 0.05$

# Corn flour

Subjects and Sex	Iron Absorption (%)					
	A	B	C	D	E	
	Basal	Basal	Basal	Basal	Basal	
	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	
	Given alone	+	+	+	+	
		American coffee 2g	Espresso coffee 4g	Capuchino coffee 4g	Espresso coffee 8g	
<u>Basal Breakfast with corn bread</u>						
1) 5M 12F	Mean	4.7	6.1	5.8	7.8	3.1
	SEM	1.3	1.5	1.5	1.3	1.5

Statistics: A vs. B  $p > 0.05$ , A vs. C  $p > 0.05$ , A vs. D  $p > 0.05$

# CONTINUOUS DETERIORATION ON QUALITY OF LIFE AND FOOD CONSUMPTION.

Diminution in consumption of cereals, eggs, fat  
and sugar between 1992 and 1997.

Precooked corn flour consumption dropped from  
110 g/person/day in 1992 to 84 g/person/day in 1997.  
Precooked corn flour sales diminished during 1998 and 1999.

Wheat flour consumption increased from 85 g/day in  
1994 to 104 g/day in 1999. This implies a reduction in  
vitamin A intake since wheat flour is not fortified  
with vitamin A, which could result in a lower  
absorption of iron compared to fortified corn flour.

## INCREASED VIRAL INFECTIONS.

C-reactive protein resulted negative in anemic subjects.

1998: 89 cases analyzed, 3 positive.

1999: 93 cases analyzed, 6 positive.

Viral infections, especially dengue, have been epidemic in Venezuela. In 1996 10.000 cases were reported increasing to 30.000 in 1997 and 35.000 during 1998.

## CHANGE IN FORTIFICATION PATTERN.

Iron absorption from arepa fortified with fumarate: 6.4%.

Iron absorption from arepa fortified with fumarate + electrolytic iron: 5.6%

It is possible that viral infections, reduction in corn flour consumption along with increase in wheat flour intake (with no vitamin A fortification), continuous deterioration on life quality and change in iron fortification pattern, could be responsible for the increase in anemia prevalence to the values found in 1992 before the fortification program started.

In spite of the fact that conditions in Venezuela continue deteriorating, this fortification program has improved iron stores and maintained prevalence of anemia.

The program should be a dynamic process, that allows to introduce changes.

There are important issues to work on:

Continuous monitoring of the fortification program.

Continue research on highly available iron compounds.

Inclusion of other nutrients such as folic acid.

Focus on fortification of food items for infants since they do not benefit from fortified flours.

Recently, Drs. Scrimshaw and Guzmán sponsored by MI and UNICEF, evaluated the fortification program in Venezuela.

They produce a document describing the fortification program since it started and obtaining information from the persons and Institutions involved in the process. This report also includes aspects as: special features of the program, lessons learned, priority research needs and recommendations.

THANK YOU



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