

IRON FORTIFICATION OF BREAD AND BAKED GOODS AS AGAINST NUTRITIONAL DEFICIENCIES OF POPULATION

Mioara NEGOIȚĂ¹, Monica CATANĂ¹, Luminița CATANĂ¹, Enuța IORGA¹,
Gabriela LILIOS², Alina BÂLEA¹, Valentin IONESCU¹

¹National Institute of Research&Development for Food Bioresources – IBA Bucharest, 021102, Bucharest 2, 6
Dinu Vintila Street, Romania, e-mail: mioaranegoita@yahoo.com

²Ovidius University, 900527, Constanța, 124 Mamaia Street, Romania, e-mail: liliosgabriela@yahoo.com

Abstract: *In Romania, according to the studies achieved by U.N.I.C.E.F., Health and Family Ministry, Institute of Mother and Child Care “Alfred Rusescu”, about 50% of 2-year aged children and about 30% of those 5-year aged have ferripriva anaemia (determined by iron deficiency). Also, according to the same studies about 25% of pregnant women and about 32% of those who suckle, have iron deficiencies and ferripriva anaemia.*

In this paper some results of the performed researches on the achievement of bread and some baked goods fortified with iron (rolls with sun flower and sesame seeds and poppy sticks) are presented. As fortification agents, ferrous sulfate, ferrous lactate and ferrous gluconate, and the fortification levels were 20 mg Fe/kg flour, 40 mg Fe/kg flour, 60 mg Fe/kg flour, 80 mg Fe/kg flour were used.

Taking into consideration the phytase role in phytates hydrolysis and increasing of iron bioavailability into human body, in bread and baked goods composition some standardised fungal phytase was added. Also, because the ascorbic acid is a promoter of the iron absorption into human body, it was used in composition of the achieved products.

Bread and baked goods fortified with iron were analysed from sensorial, physico-chemical and microbiological point of views. The used fortification agents did not modify the product sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample (bread and baked goods non-fortified with iron).

The iron content of the achieved baked goods varied in the range 3.08 – 7.53 mg Fe/100g.

Key words: *iron, content, bread, roll, poppy stick*

Introduction

In Romania, according to the studies achieved by U.N.I.C.E.F., Health and Family Ministry, Institute of Mother and Child Care “Alfred Russescu”, about 50% of 2-year aged children and about 30% of those 5-year aged have ferripriva anaemia (determined by iron deficiency). Also, according to the same studies about 25% of pregnant women and about 32% of those who suckle, have iron deficiencies and ferripriva anaemia [1].

The enrichment of food products is an essential element of nutrition strategies for

correction of micro-nutrient deficiencies. In generally, fortification of food products is acceptable from the social point of view and it is not necessary to change food habits, it does not modify the qualitative characteristics of the product, it can be easily introduced and it has nutritional advantages for target groups, it is safe from the nutritional point of view and it is economical [2].

Because bakery products have a special place within the nutrition of population in our country, it is obviously that all of these have a special interest in iron fortification. The iron compounds used for fortification

have to have a relative high bioavailability grade, have to be stable and do not cause adversely sensorial modification of products [3].

At the international level, important researches on the development of iron fortification technologies of food products [4] have been carried out.

In this paper the results of the performed researches on the achievement of bread and some baked goods fortified with iron (rolls with sun flower and sesame seeds and poppy sticks) are presented. As fortification agents, ferrous sulphate, ferrous lactate and ferrous gluconate, and the fortification levels were 20 – 80 mg Fe/kg flour were used.

Experimental

The experiments to achieve iron fortified food products were performed within the micro-production pilot plant of the National Institute of Research&Development for Food Bioresources – IBA Bucharest.

In order to obtain food products fortified with iron, more experimental variants were made, the variable factors being:

- iron fortification agent
- iron fortification level
- ascorbic acid fortification level

As fortification agents of the achieved products, we used ferrous sulphate, ferrous lactate and ferrous gluconate. In the case of baked goods, the fortification levels were of 20 mg Fe/kg flour, 40 mg Fe/kg flour, 60 mg Fe/kg flour, 80 mg Fe/kg flour.

To achieve bakery products fortified with iron, the following raw materials and materials were used: wheat flour 650, wheat flour 1250, powder milk, margarine, oil, whole egg powder, yeast, sun flower, sesame and poppy seeds, salt, standardized fungal phytase, ascorbic acid, ferrous sulphate, ferrous gluconate, ferrous lactate, polypropylene bags.



Figure. 1 Flour type 650 Flour type 1250

To achieve bakery products fortified with iron a bi-phasic method was used, because this method assures higher content of soluble iron, bio-available in human body.

The iron content of the fortified products with iron, achieved within the national Institute of Research&Development for Food Bioresources – IBA Bucharest, was determined through atomic absorption spectrometry ($\lambda = 248.3$ nm), from samples mineralised on dry way. An atomic absorption spectrometer *AAnalyst 400*, with a lamp with cathode for Fe was used. Two samples for each iron fortified product were analyzed and the arithmetic average of iron content was calculated.

Results and Discussion

Fortification of food products is legislated through *REGULATION (EC) no. 1925/2006 of EUROPEAN PARLIAMENT AND COUNCIL*, on 20 December 2006. This document specifies the following: requirements concerning the addition of vitamins and minerals, restrictions concerning addition of vitamins and minerals and vitamins and minerals sources which can be added in food products.

In the case of wheat flour fortification, in order to achieve bakery products with high nutritional value, two aspects should be taken into consideration. The first one refers to the establishment of an iron level low enough, thus through consumption of some important bread quantities and it does not imply risks for adversely effects in the human body (gastro-intestinal undesired effects, especially). At the same time, the iron level in wheat flour has to be high enough, so that the following nutritional benefits should be met: prevention and diet-therapy of iron deficiencies, of vulnerable population groups. In this sense, the tolerable superior limit of iron intake is used, that is the biggest daily iron intake which determines no risk or adversely effects on the health of population majority.

Food and Nutrition Board in U.S.A. has established in 2002 a tolerable superior limit of 40 mg iron in the case of patients with ages until 13 years and 45 mg iron, in the case of those with ages higher than 14 years, respectively. The tolerable superior limit of 45 mg iron is applied also in the case of pregnant women and of those who suckle. As critical final point of iron intake, the moment of gastro-intestinal disorders appearance has been chosen.

Flour quantity daily consumed by a person is very much variable according to food habits. For a caloric intake of 2000 kcal/day to be achieved exclusively from flour, a person has to consume 540 g flour/day. Taking into consideration this aspect and the tolerable superior limit of iron intake (45 mg/day), nutritionists established *the safe maximum limit of iron in flour at 83 mg Fe/kg*.

Within the National Institute of Research&Development for Food Bioresources – IBA Bucharest, at laboratory level, three bakery products, fortified with iron were made:

- "Iron fortified bread"
- "Roll with sun flower and sesame seeds, fortified with iron"

- "Poppy stick fortified with iron"

Taking into consideration the *safe maximum limit of iron in flour (83 mg Fe/kg)*, within the performed experiments, the following fortification levels with iron were used: 20 mg Fe/kg flour, 40 mg Fe/kg flour, 60 mg Fe/kg flour, 80 mg Fe/kg flour.

Considering the phytase role in hydrolysis of phytates in increasing iron bio-availability in human body, in the composition of bakery products standardized fungal phytase (0.1 g/kg flour) was added. Also, because ascorbic acid is a promoter of iron absorption in human body, it was used in the composition of bakery products fortified with iron (0.25 g/kg flour).

For each bakery product, fortified with iron, we made alongside control sample (bakery product unfortified with iron), 12 experimental variants (3 iron fortification agents, 4 fortification levels with iron and ascorbic acid). These ones were analysed from the sensorial, biochemical and microbiological point of views.

The sensorial analysis of bakery products fortified with iron showed that in the case of all experimental variants, the used fortification agents (ferrous sulphate, ferrous lactate, ferrous gluconate) do not lead to modification of the sensorial characteristics (appearance, colour, taste and smell), in comparison with the control sample. Thus, bakery products fortified with iron comply with the provisions of the SP 3232 – 97 „White bread”, SP 1489 – 97 „Bakery products from wheat flour”.

In the case of those 12 experimental variants, the volume of iron fortified bread is in the range 362 – 392 cm³/100g, and acidity is in the range 0.97 – 1.20 degrees, being below the provisions of SP 3232 – 97 „White bread”. Also, within the achieved experimental variants, the iron content of iron fortified bread varied in the range 3.02 – 7.45 mg Fe/100g.

Applying an American method used within the American Institute of Baking (Kansas), the iron fortified breads were given scores depending on the sensorial characteristics such as: volume, lateral cracks, crust colour, crumb colour, porosity, texture and flavour. Using this method for sensorial analysis, iron fortified breads achieved within experiments were given scores higher than 94 points.

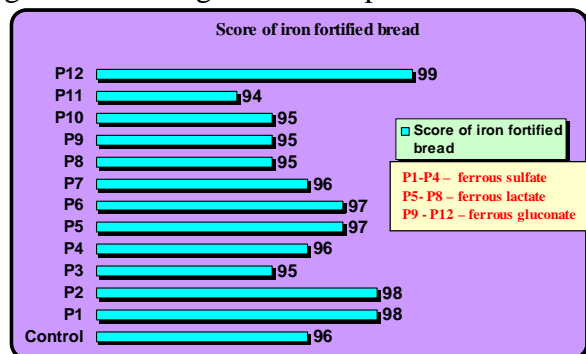


Figure 2. Score of iron fortified bread

The maximum score was obtained in the case of experimental variant P12 (bread with white flour type 650, fortification level 80 mg/kg flour, fortification agent – ferrous gluconate).



Figure 3. Iron fortified bread - P12



Figure 4. Iron fortified bread - P12

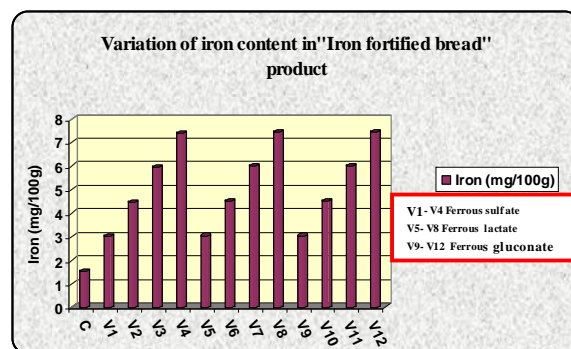


Figure 5. Variation of iron content in "Iron fortified bread" product

In the case of 12 experimental variants, the volume of rolls with sun flower and sesame seeds, fortified with iron is in the range 350 – 389 cm³/100 g, and acidity is in the range 1.42 - 1.56 degrees, complying with the provisions of the SP 1489 – 97 „Bakery products from wheat flour”. Also, within experimental variants achieved, the iron content of rolls with sun flower and sesame seeds, fortified with iron, is in the range 3.20 – 7.53 mg Fe/100 g.



Figure 6. Roll with sun flower and sesame seeds, fortified with iron – P7



Figure 7. Roll with sun flower and sesame seeds, fortified with iron – P7



Figure 10. Poppy stick fortified with iron

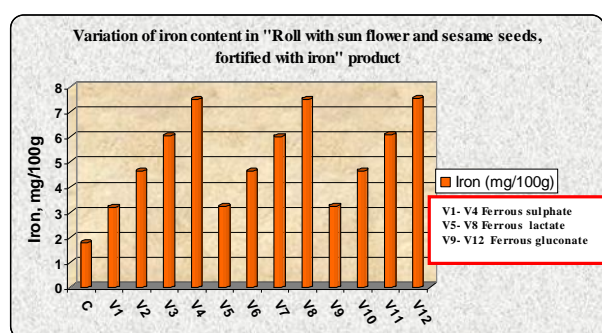


Figure 8. Variation of iron content in "Roll with sun flower and sesame seeds, fortified with iron" product

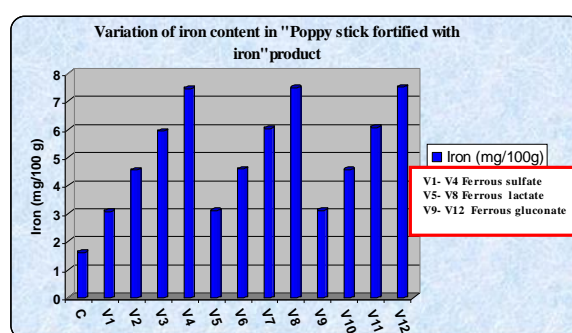


Figure 11. Variation of iron content in "Poppy stick fortified with iron" product

In the case of those 12 experimental variants, the volume of poppy sticks fortified with iron, is in the range 309 – 390 cm³/100 g, and acidity is in the range 1.67 - 1.92 degrees, complying with the provisions of the SP 1489 – 97 „Bakery products from wheat flour”. Also, within experimental variants achieved, the iron content of poppy sticks fortified with iron is in the range 3.08 – 7.50 mg Fe/100 g.



Figure 9. Poppy stick fortified with iron (ferrous sulfate)

Bread and baked goods fortified with iron can be used for prevention and diet therapy of iron deficiencies of vulnerable groups within population (children, teenagers, pregnant women).

Conclusion

1. In the National Institute of Research&Development for Food Bioresources – IBA Bucharest three bakery products, fortified with iron "Iron fortified bread", "Roll with sun flower and sesame seeds, fortified with iron", "Poppy stick fortified with iron" were made.

2. The use of fortification agents has not determined modification of sensorial characteristics (appearance, colour, taste and smell), of baked goods fortified with iron, in comparison with those of control products.

3. The iron content of the achieved baked goods varied in the range 3.02 – 7.53 mg Fe/100g.

4. Bread and baked goods fortified with iron, can be used for prevention and diet therapy of iron deficiencies of vulnerable groups within population (children, teenagers, pregnant women).

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