IRON FORTIFICATION OF BAKERY PRODUCTS

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Abstract
In this paper are presented the results of performed researches for achieving of two bakery products fortified with iron: rolls with sun flower and sesame seeds and poppy sticks. As fortification agents, they were used 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 and 80 mg Fe/kg flour, respectively. Taking into consideration the phytase role into phytates hydrolysis and increasing of iron bioavailability in human body, in bakery products composition it was added standardized fungal phytase. 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. Bakery products fortified with iron were analysed from sensorial, physic-chemical and microbiological point of views. The used fortification agents do not modify product sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample (bakery products, non-fortified with iron).

Keywords: fortified, bakery products, iron salts

1. INTRODUCTION

In Romania, according to studies achieved by U.N.I.C.E.F., Health and Family Ministry, Institute of Mother and Child Care “Alfred Russescu”, about 50% of children aged to 2 years and about 30% of those aged to 5 years have ferrifree anemia (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 ferrifree anemia.

Enrichment of food products it is an essential element of nutrition strategies for correction of micro-nutrient deficiencies. In generally, fortification of food products is acceptable from social point of view and it is not necessary to change food habits, it is not modify the qualitative characteristics of the product, it can be easy introduce and it has nutritional advantages for task groups, it is safe from nutritional point of view and it is economical (Marin et al., [5]).
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 for iron fortification. Iron compounds used for fortification have to have a relative high bio-availability grade, have to be stable and do not cause adversely sensorial modification of products (Ciobanu, [6]).
Iron salts (ferrous sulfate, ferrous gluconate, and ferrous lactate) soluble in water determine a high bio-availability of iron in human body, and then they are used as fortification agents of food products (Hurrell, [2]).

2. MATERIAL AND METHODS

Experiments performed for achievement of bakery products fortified with iron, were done within micro-production pilot plant of the Institute of Food Bioresources.
In the performed experiments were used the following raw materials and materials: wheat flour 650, wheat flour 1250, powder milk, margarine, oil, whole egg powder, yeast, sun flower, sesame and poppy seeds, salt, standardized fungal phytase, fungal α – amylase, ascorbic acid, ferrous sulfate, ferrous gluconate, ferrous lactate, polypropylene bags. For achieving of bakery products fortified with iron, they were covered the following phases:
- quality analysis of the used wheat flour in experiments (sensorial and physic-chemical characteristics, farinogram)
- achievement, in much more experimental variants, of product "Roll with sun flower and sesame seeds, fortified with iron" and "Poppy sticks fortified with iron"
- microbiological, sensorial and biochemical analyses of bakery products, fortified with iron
- finalization of manufacturing recipes and selection of optimal variant, from sensorial and nutritional point of views

For quality analysis of raw materials and bakery products, fortified with iron, they were used specific standardised methods.

Within the achieved experimental variants, the variable factors has been:
- iron fortification agent
- iron fortification level

For preparation of bakery products fortified with iron it was used bi-phasic method, because this method assures a higher content of soluble iron, bio-available in human body. In the same time, preparation of bakery products fortified with iron, through bi-phasic method, has comparative with the mono-phase one, the following advantages (Ciobanu, [6]):
- technological flexibility; a lower yeast consumption
- superior porosity and elasticity of product crumb
- product specific taste and flavor

Thus, both in the case of control sample and of the experimental variants, for achieving of fortified bakery products, it was covered the following technological flow: preparation of raw materials and materials, sponge mixing, sponge fermentation, dough mixing, dough fermentation, division, modeling, final proofing, finishing, baking, cooling, packaging.

3. RESULTS AND DISCUSSION

Fortification of food products is legislate through REGULATION (EC) no. 1925/2006 of EUROPEAN PARLIAMENT AND COUNCIL, on 20 December 2006. In this document are specified: requirements concerning adding of vitamins and minerals, restrictions concerning adding 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, it has to take into consideration two aspects. The first one refers to the establishment of an iron level low enough, thus through consumption of some important bread quantities it is not the risk for adversely effects in the human body (gastro-intestinal undesired effects, especially). In the same time, the iron level in wheat flour has to be high enough, so that it will be meet the nutritional benefit followed: prevention and diet-therapy of iron deficiencies, of vulnerable population groups. In this sense, it is used the tolerable superior limit of iron intake, that is the biggest daily iron intake which determines not a risk or adversely effects on the health of population majority.

In European Union, consultations concerning the superior limit of iron intake, they are not finished. In 1992, the Scientific Committee concerning Food (S.C.F.) has shown that the secondary effects at adults can appear, already, at levels of only 30 mg elementary iron; nevertheless, they were tolerated unique doses of 100 mg.

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 it is applied also in the case of pregnant women and of those who suckle. As critical final point of iron intake, it was choose moment of gastro-intestinal disorders appearance.

Flour quantity daily consumed by a person it is very much variable according to food habits. For that 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 Institute of Food Bioresources, they were achieved, at laboratory level, two bakery products, fortified with iron:

- "Roll with sun flower and sesame seeds, fortified with iron"
- "Poppy stick fortified with iron"

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

Considering phytase role in hydrolysis of phytates and increasing of iron bio-availability in human body, in the composition of bakery products it was added standardized fungal phytase (0.1 g/kg flour). 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, they were achieved alongside control sample (bakery product unfortified with iron), 12 experimental variants (3 iron fortification agents, 4 fortification levels with iron and ascorbic acid). These were analysed from sensorial, biochemical and microbiological point of views.

Sensorial analysis of products "Roll with sun flower and sesame seeds, fortified with iron" and "Poppy stick fortified with iron" shown that in the case of all experimental variants, the used fortification agents (ferrous sulfate, ferrous lactate, ferrous gluconate) do not lead to modification of sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample. Thus, rolls with sun flower and sesame seeds, fortified with iron and poppy sticks fortified with iron, are in conformity 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.

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, being in conformity 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.

After assessment of sensorial and biochemical characteristics of those two bakery products fortified with iron, they were selected as optimal variants, for each fortification agent, the following:

- V3 (fortification agent ferrous sulfate)
- V7 (fortification agent ferrous lactate)
- V11 (fortification agent ferrous gluconate)

After microbiological analysis, it was concluded that the bakery products fortified with iron are in conformity with the provisions of legislation in force from microbiological point of view.

Figure 1. Rolls with sun flower and sesame seeds, fortified with iron
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.

2. Sensorial analysis of bakery products fortified with iron, shown that the used fortification agents do not determine modification of sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample.

3. Iron content of achieved bakery products "Roll with sun flower and sesame seeds, fortified with iron" and "Poppy stick fortified with iron" is in the range: 3.08 – 7.53 mg Fe/100 g.

4. Bakery products fortified with iron are destined to nutrition of individuals with ferriprive anemia: children, teen-agers, pregnant women, elders, etc.

5. ACKNOWLEDGEMENTS

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4. CONCLUSIONS

1. They were achieved, at laboratory level, two bakery products, fortified with iron: "Roll with sun flower and sesame seeds, fortified with iron" and "Poppy stick fortified with iron". As fortification agents they were used ferrous sulfate, ferrous gluconate and ferrous lactate,