IRON FORTIFICATION OF FRUIT-BASED CONCENTRATED PRODUCTS

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Abstract
In this paper are presented the results of performed researches for achievement of two fruit-based concentrated products (apricots, plums) fortified with iron. As fortification agents, they were used ferrous sulfate, ferrous lactate and ferrous gluconate, and the fortification levels were 4 mg/100 g end product and 6.5 mg/100 g end product, respectively. Increasing of iron bio-availability in the human body and, in the same time, assurance of an optimal acidity of fruit-based concentrated products had been done by adding of ascorbic acid in their composition. Fruit-based concentrated products fortified with iron were analysed from sensorial, biochemical 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 (jams non-fortified with iron).

Keywords: fortified, iron salts, apricots, plums

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 ferrisirve 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 ferrisirve anemia. Enrichment of food products with micro-nutrients it is an essential element of strategies against nutritional deficiencies, of iron deficiency, especially, of population within developing countries. Adding of one micro-nutrient has to be done based on scientific researches, so that its concentration in product to be optimal for correction of nutritional deficiency, but, in the same time to keep the sensorial properties of product (appearance, taste, smell, colour) (Berger, [1]).

At the international level, they were achieved important researches for development of iron fortification technologies of food products (Mehansho, [3]).

Although, comparative with meat products, processed fruits have lower iron content, nutritionists recommend them in diet-therapy of iron deficiencies. Researches achieved by nutritionists underline that, the value of a food product, as iron source, is influenced more much by chemical state of this element than of its total iron content. High solubility, easy ionization and ferrous valence are properties which increase iron assimilation grade. In case of fruits, due to ascorbic acid content, trivalent iron is reduced to bivalent iron, which favors its bio-availability in human body (Mogoș, [4]).

2. MATERIAL AND METHODS

Experiments performed for achievement of fruit-based concentrated products, fortified with iron, were done within the micro-production pilot plant of the Institute of Food Bioresources.

In the performed experiments were used the following raw materials and materials: apricots (Cea mai bună de Ungaria variety), plums (Stanley variety), sugar, nut, ascorbic acid, ferrous sulfate, ferrous gluconate, ferrous...
lactate, glass jars with 370 mL capacity (Twist – off closing system).

For analysis of quality of raw materials and fruit processed products, fortified with iron, were used specific methods, standardised. Within the achieved experimental variants, the variable factors has been:
- iron fortification agent
- iron fortification level
- ascorbic acid fortification level

Both in control sample and experimental variants for achievement of fruit-based concentrated products, fortified with iron, was the following technological flow: raw materials, materials and packaging reception, sorting, washing, cleaning - division, product preparation, packaging preparation, dosing, closing, pasteurisation, cooling, conditioning of full jars, storage.

3. RESULTS AND DISCUSSION

In food industry, for achievement of fortified products, the big companies well-known in the field, follow two main directions:

✓ Use of some raw materials with high content in nutritive principles and applying of some optimal processing technologies, in order to preserve in the end product of high rate of them

✓ Fortification of the end product through adding of vitamins (A, C, E, etc.) and minerals (iron, calcium, magnesium)

Because the iron deficiency and feriprive anemia have an increased incidence among the vulnerable population groups (children, teenagers, pregnant women, etc.), achievement of some fruit-based processed products, fortified with iron, represents a necessity.

Taking into consideration all these aspects, in our researches performed at laboratory level there were achieved two fruit-based processed products, fortified with iron:
- "Apricots jam with nut, fortified with iron"
- "Plums jam fortified with iron"

In the same time, were achieved control samples of fruit-based processed products (products unfortified with iron).

Fruit varieties used in the experiments have superior sensorial characteristics (appearance, taste, flavor) and have a complex biochemical
composition, excelling through glucides, vitamin C, minerals and β – carotene content (only apricots).

Fortification of food products is legislate through REGULATION (EC) no. 1925/2006 of EUROPEAN PARLIAMENT AND COUNCIL, on 20 December 2006. Also, Directive 2006/125/EC of European Community Commission on 5 December 2006, concerning cereal-based preparations and food products for children, destined suckers and infants, imposes a maximum limit for iron adding in order to fortify: 3 mg Fe/100 kcal. Taking into consideration this recommendation, in the case of the two products "Apricots jam with nut, fortified with iron" and "Plums jam fortified with iron" were achieved the following fortification levels:

- 4 mg Fe/100 g end product
- 6.5 mg Fe/100 g end product

For increasing of iron bio-availability in the human body and, concomitantly, for assurance of an optimal acidity of fruit-based concentrated products, fortified with iron, in their composition was added ascorbic acid, in the following concentrations:

- 70 mg ascorbic acid/100 g product, 95 mg ascorbic acid/100 g product (in case of product "Apricots jam with nut, fortified with iron")
- 90 mg ascorbic acid/100 g product, 125 mg ascorbic acid/100 g product (in case of product "Plums jam fortified with iron")

For each fruit-based concentrated product fortified with iron were achieved, alongside control samples (concentrated products, unfortified with iron), 12 experimental variants (3 iron fortification agents, 2 iron and ascorbic acid fortification levels). All of them were analysed from sensorial, biochemical and microbiological point of views.

Sensorial analysis of products "Apricots jam with nut, fortified with iron" and "Plums jam fortified with iron" proved that in the case of all experimental variants, the used fortification agents (ferrous sulfate, ferrous lactate, ferrous gluconate) do not determine modification of sensorial characteristics (appearance, colour, taste and smell), in comparison with control sample (jams unfortified with iron). Thus, the two fruit-based concentrated products, fortified with iron (fortification agents: ferrous sulfate, ferrous lactate, ferrous gluconate) are in conformity with provisions of SR 3183:1990 „Jams” from sensorial point of view.

According to biochemical analysis, product "Apricots jam with nut, fortified with iron" achieved in 12 experimental variants has high nutritional value, excelling through content of soluble glucides, minerals, β – carotene and ascorbic acid.

Iron content of product "Apricots jam with nut, fortified with iron" is in the range 4.48 – 7.05 mg/100 g, and those of ascorbic acid in the range 21.58–32.75 mg/100 g. After assessment of sensorial and nutritional characteristics of this product they were selected, as optimal variants, for each fortification agent, the following:

- V4 (fortification agent ferrous sulfate)
- V8 (fortification agent ferrous gluconate)
- V12 (fortification agent ferrous lactate)

According to biochemical analysis, product "Plums jam fortified with iron", achieved in 12 experimental variants, has high nutritional value, excelling through content of soluble glucides, minerals and ascorbic acid. Iron content of product "Plums jam fortified with iron" is in the range 4.27 – 6.80 mg/100 g, and those of ascorbic acid in the range 28.95 – 40.15 mg/100 g. After assessment of sensorial and nutritional characteristics of this product they were selected, as optimal variants, for each fortification agent, the following:

- V4 (fortification agent ferrous sulfate)
- V8 (fortification agent ferrous gluconate)
- V12 (fortification agent ferrous lactate)

Microbiological analysis shown that fruit-based concentrated products, fortified with iron, achieved in 12 experimental variants and control samples, are in conformity with legislation in force from microbiological point of view.
4. CONCLUSIONS

1. They were achieved, at laboratory level, two fruit-based processed products, fortified with iron: "Apricots jam with nut, fortified with iron" and "Plums jam fortified with iron". As fortification agents they were used ferrous sulfate, ferrous gluconate and ferrous lactate, and fortification levels were 4 mg Fe/100 g end product, 6.5 mg Fe/100 g end product, respectively.

2. Sensorial analysis of fruit-based processed 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 samples (apricots jam, plums jam, respectively, unfortified with iron).

3. Biochemical analysis shown that the two achieved products "Apricots jam with nut, fortified with iron" and "Plums jam fortified with iron" have a complex composition, excelling through content of simple glucides, easy assimilable, vitamin C and iron.

5. ACKNOWLEDGEMENTS

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