



Tópicos em Nutrição e Tecnologia de Alimentos 2

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Tópicos em Nutrição e Tecnologia de Alimentos 2

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APRESENTAÇÃO

O *e-book* Tópicos em Nutrição e Tecnologia de Alimentos vol. 2 traz 26 artigos científicos na área de Nutrição e Tecnologia de Alimentos, abordando assuntos como desenvolvimento e análise sensorial de alimentos, composição físico-química e avaliação microbiológica de produtos, avaliação nutricional de cardápios, desperdício alimentar em unidades de alimentação coletiva, estado nutricional e comportamento alimentar de pacientes, marketing na nutrição, gastronomia aliada ao turismo, entre outros diversos temas.

Diante da leitura dos artigos que compõem esse *e-book* o leitor conseguirá integrar a Nutrição e Tecnologia de Alimentos, além de atualizar-se com temas de suma importância e relevância.

Desejamos a todos uma excelente leitura!

Vanessa Bordin Viera
Natiéli Piovesan

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DEVELOPMENT OF A REFRESHMENT THAT CAN PROVIDE A SOURCE OF IRON AND VITAMIN A: AN ALTERNATIVE FOR CHILDREN UNDER 6 YEARS OF AGE

DEVELOPMENT OF A REFRESHMENT WITH IRON AND VITAMIN A

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ABSTRACT: The objective of this work was to develop a refreshment, consisting of tasty fruits and vegetables with high levels of vitamin A and iron, for children under 6 years old. Three refreshment formulations were developed and submitted to an affective sensory test of preference with 24 children from 5 to 6 years old. From the chosen formulation, microbiological and physio-chemical analyses were performed via membrane filtration and analysis of total and thermotolerant coliforms and total carbohydrates in sucrose, total acidity, electrometric determination of pH, density per pycnometers, determination of dry residue, waste by incineration, determination of vitamin A, and quantitative determination of iron. A pilot test was performed with a child having a low serum level of iron and vitamin A, who ingested the refreshment daily for 3 months, and blood was collected after this period. The sensory

analysis demonstrated 60% preference for the formulation chosen. The microbiological and physio-chemical properties were in accordance with legislation, and the pilot study showed a satisfactory increase in the hemoglobin and hematocrit values. The refreshment will be an additional alternative for children with vitamin A and iron deficiencies.

KEYWORDS: Refreshment, vitamin A, iron deficiency anemia.

PRACTICAL APPLICATION

Every day thousands of parents return to the attention of supermarkets in search of more natural products that provide acceptable nutritional and sensory characteristics to minimize health problems and offer better development to their children. Industrially the refreshment developed can be a substantially essential alternative to aid in infant feeding, adding a healthy way to the consumer's table, so that it can be applied simply to the diet of children around the world.

INTRODUCTION

Iron and vitamin A deficiencies are great nutritional problems that affect mainly preschool-aged children and pregnant and lactating women. It is estimated that anemia

(iron deficiency) affects 18% and 19% of children younger than 5 years of age and pregnant women, respectively, while 35% of children younger than 5 and 15% of pregnant women suffer from vitamin A deficiency (AARON e YANG, 2015; ABU-OUF e JAN, 2015; MICHELAZZO et al., 2013). Anemia in children is an important public health problem in both developed and developing countries, mainly due to the low intake of iron, that affects approximately 293 million preschool-aged children, and it is responsible for more than 50% of the cases of anemia in children younger than 5 years of age, impairing their growth and cognitive development (CHANDYO et al., 2015; CARDOSO, 2016; ZANIN et al., 2015; ABU-OUF e JAN, 2015). As vitamin A deficiency affects the majority of developing countries, occurring because of a nutritional deficiency, usually from breastfeeding, it is the main nutritional concern in poor communities, particularly in low-income countries (ABRHA et al., 2016; VITERI e SÁDABA, 2016).

Iron deficiency anemia results in changes in energy metabolism in the brain with defects in myelination and the function of neurotransmitters, and it is also associated with an impairment of motor development and cognitive performance, as well as fatigue, sleep disorders, irritability, and poor memory and school performance; it also causes a decrease in the supply of oxygen to tissues (ABU-OUF e JAN, 2015). Vitamin A deficiency is associated with an increased severity of respiratory and gastrointestinal diseases, in addition to an increased incidence of infection, mainly due to a decrease in the mucosal immune system and the weakening of humoral and cellular immunity. If left untreated, this nutritional deficiency can progress to permanent visual loss, prolonged malnutrition and malabsorption, or abnormal metabolism (ABRHA et al., 2016; VITERI e SÁDABA, 2016). Studies suggest that the metabolism of vitamin A and iron are interrelated, such that in organisms with vitamin A deficiency, the systemic availability of iron is significantly reduced; likewise, the simultaneous supplementation of both vitamin A and iron seems to be more effective than the use of these micronutrients alone (MICHELAZZO et al., 2013; MENDES et al., 2016). The use of functional foods, which are characterized as foods or drinks that can provide specific physiological benefits and beneficial properties beyond basic nutrition, when consumed as part of the daily nutrition, is considered as an option for the treatment of certain pathologies, such as nutritional problems (vitamin A deficiency and iron), because these foods have the capacity to regulate bodily functions. Thus, the objective of this study was to develop a functional refreshment with high levels of vitamin A and iron to assist in the treatment of anemia and vitamin A deficiency in children younger than 6 years of age.

MATERIALS AND METHODS

The research was carried out in the laboratories of sensory analysis and microbiology at the University of Contestado, during the period of December 2015 to June 2017 and consisted of 5 steps: I) development of the refreshment; II) sensory analysis; III) physical-chemical and microbiological analyses of the new product; (IV)

pilot study; and V) analysis of the results.

I) Development of the refreshment: The development of the refreshment was initially carried out based on research of food sources of vitamin A and iron. Different formulations of leafy vegetables, fruits, and non-leafy vegetables rich in these nutrients, which together formed a tasty combination, were tested. From these formulations, the 3 combinations of ingredients that showed a higher content of vitamin A and iron, along with a pleasant flavor, based on the preliminary evaluation of the researchers, were subjected to sensory analysis.

II) Sensorial Analysis: To achieve effective sensory analysis, or analysis of preference, the study was submitted to the Ethics Committee of the University of disputed, to obtain approval under n°. 1,513.712/2016. After approval, 24 children, 5 to 6 years-old, from a school in Oeste Catarinense, were invited to participate in the research, which was subject to authorization via an informed consent form signed by their parents/guardians. Once accepted, the 24 children underwent sensory analysis of 3 refreshment formulations using the affective sensory method of preference, where each child received a response card containing the letters A, B, and C, and each letter was shown on a different refreshment formulation. Then, the refreshments, which were separated and in individual cups with their letters, were distributed. After all of the children had experienced all 3 formulations, the researcher explained that they should color the letter of favorite refreshment on the response card.

III) Physical-chemical and microbiological analyses: Using the formulation chosen from the sensory analysis, microbiological analyses were performed via membrane filtration and analysis of total and thermotolerant coliforms, and physical-chemical analysis was conducted to determine the total carbohydrates in sucrose (040/IV), total acidity (253/IV), electrometric determination of pH (017/IV), density per pycnometers (011/IV), determination of the dry residue (259/IV), and waste by incineration (018/IV) at the Laboratory of Food Technology of UnC/ Concórdia. The determination of vitamin A (retinol-A7272) and the sample digestion (AOAC 999.10/adapted) for quantitative determination of iron (AOAC/2013.06) were conducted at the Laboratory ALAC Ltd. in Bento Gonçalves in Brazil - 2017 (BRAZIL, 2003; GOLDBECK, 2008; BRAZIL, 2008).

IV) Pilot Study: Initially, a survey of blood tests (blood count) of patients was conducted in the clinical analysis laboratory of the Camillian Beneficence of the São Francisco Hospital, west of Santa Catarina, in the period of 08/01/2016 to 08/31/2016. Four thousand three hundred seventy-nine examinations were evaluated, and the hemoglobin (Hb) and hematocrit (Ht) values from 1250 of the exams are shown below for your reference. To conduct a pilot study, the examinations of patients between 3 and 6 years old were separated for consideration of the Hb and Ht values, while noting Hb below 11.5 g/dl and Ht below 34.0%. The triage of patients was performed after contacting the parents/guardians of the children with values below the Hb and Ht standards, and selecting for children under 4 years of age, of male sex, healthy, white in color, and with a normal BMI (Body Mass Index). After meeting with the parents

of the child, they signed at the end of the assent and commitment forms, and the pilot study was initiated, which consisted of the daily ingestion of the refreshment (the developed drink with the best sensory acceptance) and monitoring of the child for 3 months. After 3 months, 5 mL of venous blood was collected from the child according to the World Health Organization (WHO) to check the markers of iron and vitamin A and thus, assess the effectiveness of the refreshment.

RESULTS AND DISCUSSION

For the development of the refreshment, 3 tests were performed with various combinations of fruits and vegetables with a high content of iron and vitamin A that possessed organoleptic characteristics that would allow for a positive combination of flavor and texture. Table 1 presents the 3 formulations developed in previous tests conducted by the researchers.

FORMULATION 1		FORMULATION 2		FORMULATION 3	
Component	Quantity(%)	Component	Quantity (%)	Component	Quantity (%)
Raw Beetroots	10	Raw Carrot	16	Raw Beetroots	7
Raw Carrot	11	Raw cabbage butter	2,5	Raw Carrot	7,5
Raw cabbage butter	2	Fugi Apple with raw rind	80,5	Raw cabbage butter	1
Fugi Apple with raw rind	56	Raw Parsley	1	Fugi Apple with raw rind	20
Raw Haden Mango	20			Raw Haden Mango	14
Raw Parsley	1			Watermelon	50
				Raw Parsley	0,5

Table 1 - Consumables and their respective concentrations of three formulations of refreshments developed

Source: The author, (2017).

All formulations presented in Table 1 have high amounts of vitamin A and iron, according to calculation based on Table TACO, set forth in Table 2 (BRAZIL, 2011).

Mineral/ Formulation	Formulation 1	Formulation 2	Formulation 3
Vitamin A - RE (mcg)	846,5	700,70	1038,50
Iron (mg)	0,7	0,45	1,2050

Table 2 - Quantity of vitamin A and iron contained in Table 3 formulations, as TACO.

Source: (BRAZIL, 2011).

With the 3 formulations, sensorial analysis was performed by the affective method of preference to obtain the following rates of acceptance (Chart 1). Formulation B (2) obtained 60% acceptance (15 votes), followed by formulation C (3) with 29% (7 votes) and formulation A (1) with 11% (2 votes).

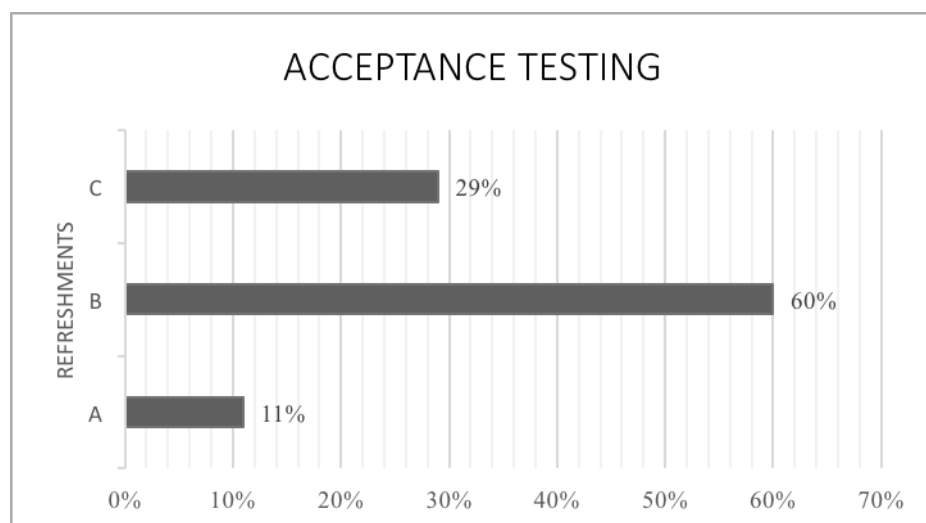


Chart 1 - acceptance rate for each formulation tested.

Source: The author, (2017).

From the results of the sensorial analysis, formulation B, which contained raw carrot, raw cabbage butter, Fuji apple with raw rind, and raw parsley, was chosen as the refreshment to study further in the pilot study and for the analysis of clinical cases. To examine the microbiological quality, the refreshment was analyzed by membrane filtration for total and thermotolerant coliforms, both of which showed negative results. To verify the physicochemical characteristics of the final refreshment formulation for a high content of vitamin A and iron, tests were performed to determine the total carbohydrates in sucrose, total acidity, electrometric determination of pH, density per pycnometers, determination of dry residue, waste by incineration, determination of vitamin A, and quantitative determination of iron; the results of the tests are presented in Table 3.

Analysis	Result
Total carbohydrates in sucrose	6,3
Total acidity	1,175mL
Ph Determination	3,92
Density per pycnometers	1,153
Determination of dry residue	2,7061
Waste by incineration	0,013
Vitamin A Determination	< 21ug/100g
Quantitative determination of iron	< 0,560mg/100g

Table 3 - physico-chemical characterization of refreshment (formulation (B))

Source: The author, (2017).

In conjunction with the results of the physical-chemical analysis, a literature search was performed of prior reports and the current legislation. Normative Instruction N° 17 of 2003, Art 2, which established the complementation of standards for the identity and quality of refreshments, soft drinks, composite drinks, tea ready for consumption, and soda, mentions that it is necessary to contain at least 2 g of vegetables and/or fruit in the composition of juice (BRAZIL, 2003). The refreshment developed in this work meets this standard and is completely natural, consisting only of vegetables and fruits without added sugar. Concerning the amount of fruits and vegetables in a prepared refreshment, decree no. 6.871/2009 mentions that soft fruits, in general, have a quantity between 10% and 20% of juice from the fruit. The refreshment developed and chosen by the sensorial analysis contains 80% apple and can therefore be considered as a refreshment (BRAZIL, 2009). Furthermore, legal parameters were not found for the remaining result parameters, and there are only a few previous studies. However, ordinance No. 544/1998 describes the content of acidity for some juices, such that the acidity must be at least 0.05 for malic acid (g/100 ml), while the total acidity content of the whole refreshment can be 1,175 ml (BRAZIL, 1998); for the developed refreshment basically of apple juice. For comparison, a study by Frata (2006) using orange juice with a low and high content of conventional pulp and pasteurized juice resulted in a total titratable acidity that ranged from 0.61 g of citric acid/100 mL to 0.63 g of citric acid/100 mL, which can be considered relatively low (FRATA, 2006).

However, in the same study, the pH of the developed refreshment of 3.92, which was presented with variations, was classified as a favorable pH, because in a study by Silva (2013) that analyzed blends of tropical fruits and vegetable extracts, the pH was found to be lower than 4.5, which was adequate to ensure the microbiological stability (SILVA, 2013). As for the amount of vitamin A and iron in a refreshment, Public

Consultation No. 80/2004 of the National Agency of Sanitary Surveillance (ANVISA) indicates that the recommended daily intake of vitamin A is 450 mcg ER/d (equivalent of retinol) and 6 mg/d for iron for children between 4 and 6 years old. Based on the results of the physical-chemical analysis of the formulated refreshment in the present study, we observed amounts of vitamin A and iron that were favorable and in accordance with the objective of the study (BRAZIL, 2004). For the results of the pilot study, the survey data showed that from 4379 exams, 28.54% (1250) presented with altered Hb and Ht values that were below the reference value for each age; of the examinations, 625 patients were male and 624 were female, as shown in Chart 2.

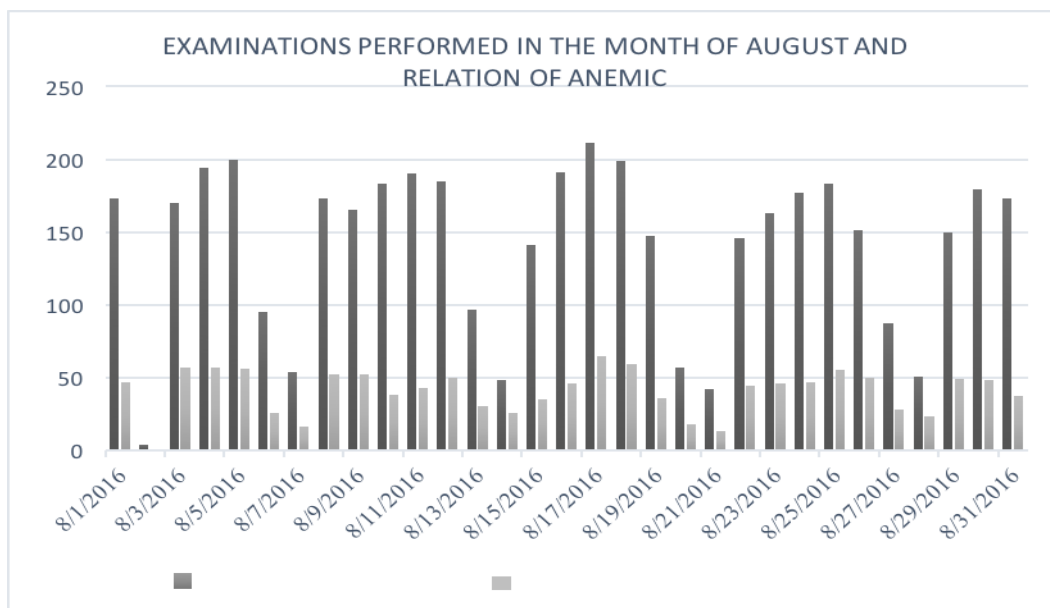


Chart 2 - Representation of the amount of tests evaluated and altered tests in the clinical analysis laboratory of the Camillian Beneficence - São Francisco Hospital.

Source: The author, (2017).

The pilot study with the child participant demonstrated that daily use of the refreshment, 1 glass per day (about 200 ml) after lunch, for 3 successive months, together with a balanced diet of fruits and vegetables and an appropriate routine, secured an increase in the serum values of Hb and Ht. The results of the blood tests for Hb and Ht before and after the daily consumption of the refreshment are shown in Table 4.

Hemoglobin		Hematocrit	
Reference value: 11,5 - 13,5g/dL		Value of reference: 34,0 - 40,0%	
Before (05/09/2016)	11,2g/dL	Before (05/09/2016)	33,3%
After (02/03/2017)	11,9g/dL	After (02/03/2017)	36,1%

Table 4 - reference values of hemoglobin (Hg) and hematocrit (Ht), and values of the child

before and after the daily consumption of refreshment.

Source: The author, (2017).

Fruits and vegetables are essential in food, especially for children. They are sources of vitamins, minerals, and fiber and still contain antioxidants that aid in the prevention of diseases. At least five portions a day should be consumed to ensure smooth function and development of the body (PEREIRA, 2014). In various studies, fruits and vegetables have been implemented into foods to increase the level of vitamins and minerals that are important for physiological function. Sousa et al. (2011) in a study about fruits, vitamins, minerals, fiber, and antioxidant compounds, determined that these have major functions in the body. As well as the iron, essential in physiological functions, which participates in various metabolic reactions, present in several enzymes (SOUSA et al., 2011; DELGADINHO, 2014). According to Pereira (2014), drinks with fruit juices and their mixtures have been used for the incorporation of high concentrations of functional ingredients with different sensory and nutritional properties, in order to facilitate the meeting of human requirements and to combine components for the development of new functional products, which have been described by the Brazilian Society of Functional Foods (SBAF) (2007) as a functional food or ingredient which, in addition to the basic nutritional functions, produces metabolic effects and/or physiological benefits for health, when consumed as part of the usual diet; the food or ingredient should be safe for consumption without medical supervision, upon proof of the efficacy and safety through scientific studies (PEREIRA, 2014). The present study evaluated the effectiveness of a developed refreshment, composed only of fruit and vegetables, through physical-chemical and microbiological analyses and also by means of a pilot study, from which, it can be suggested that the developed functional refreshment obtained satisfactory results and proved to be a possible alternative to additional treatment in children (3 to 6 years old) with iron deficiency anemia and vitamin A deficiency, although other scientific studies are necessary.

CONCLUSIONS

It is known that the deficiency of iron and vitamin A is a serious public health problem that affects different countries, especially in preschool-aged children and pregnant and lactating women. This deficiency results in changes in the metabolism, development, and cognitive performance, as well as systemic disorders in the organism, in addition to an increased severity of certain diseases and decreases in the immune system, leaving the organism susceptible to various infections. It is of great importance to decrease the incidence of this nutritional deficiency, because if not treated, it can lead to irreversible complications, such as permanent visual loss, prolonged malnutrition, and even an abnormal operation of the organism.

Therefore, this study has shown that a combination of natural products can adhere

to the supply, together with a balanced diet, in order to meet needs and nutritional deficiencies, and that the functional refreshment developed, composed of raw carrot, raw cabbage butter, Fuji Apple with raw rind, and raw parsley, is rich in vitamin A and iron. This refreshment can be used to reduce the rates of anemia in children, particularly those younger than 5 years old.

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