

Insertion of food sources of flavonoids in the National School Feeding Program: literature review

Inserção de alimentos fontes de flavonoides no Programa Nacional de Alimentação Escolar: revisão de literatura

Camila Máximo dos Reis *, Karina Zanoti Fonseca 

ABSTRACT

The supply of food for the school life stage is essential for promoting growth and proper development. Students in Brazilian public schools have the guaranteed right of access to food in the school environment through the National School Feeding Program (PNAE - Portuguese acronym). Flavonoids are bioactive compounds of nutritional importance, mainly to prevent and/or combat chronic Noncommunicable diseases (NCD), a group of leading cause of death worldwide diseases representing an emerging global health threat that have increasingly affected children and adolescents. The objective of this article was to analyze the nutritional relevance of the inclusion of foods that are sources of flavonoids in school meals. A literature review was carried out based on the exploratory reading of full texts through the Scientific Electronic Library Online - SciELO, the Public Medline - PubMed database published from 2011 to 2021 and the documents linked to the Ministries of Education, of Health and the American Dietetic Association. In this review, in order to understand the theme, the conceptualization, the historical context and the purchase of food from the PNAE, the nutritional situation of schoolchildren in Brazil and the inclusion of flavonoids in school meals were addressed. It was concluded that food sources of flavonoids are relevant from a nutritional point of view for schoolchildren to prevent NCD and that they can be easily inserted into the school menu, as they are easily accessible and meet all the requirements recommended by the PNAE.

Keywords: Health. Healthy eating. Functional food. Schoolchildren.

RESUMO

A oferta de alimentos saudáveis para indivíduos em fase escolar é fundamental para favorecer o crescimento e o desenvolvimento adequados. Os estudantes das escolas públicas brasileiras possuem o direito garantido de acesso à alimentação no ambiente escolar por meio do Programa Nacional de Alimentação Escolar (PNAE). Os flavonoides são compostos bioativos de importância nutricional, principalmente para a prevenção e/ou combate das doenças crônicas não transmissíveis (DCNT), que são as doenças que mais matam no mundo e têm atingido, cada vez mais, crianças e adolescentes. O objetivo deste artigo foi analisar a relevância nutricional da inserção de alimentos fontes de flavonoides na alimentação escolar. Realizou-se uma revisão de literatura pautada na leitura exploratória de textos completos selecionados através da biblioteca on-line *Scientific Electronic Library Online - SciELO*, da base de dados *Public Medline - PubMed* publicados no período de 2011 a 2021 e dos documentos vinculados aos Ministérios da Educação, da Saúde e da *American Dietetic Association*. Nesta revisão, para compreensão do tema, foram abordadas a conceituação, o contexto histórico e a aquisição de alimentos do PNAE, a situação nutricional de escolares no Brasil e a inserção de flavonoides na alimentação escolar. Concluiu-se que os alimentos fontes de flavonoides são relevantes do ponto de vista nutricional para os escolares ao prevenirem as DCNT e que podem ser facilmente inseridos no cardápio escolar, por contemplarem todos os requisitos preconizados pelo PNAE, como por serem de fácil acesso.

Palavras-chave: Alimentação saudável. Alimento funcional. Escolares. Saúde.

INTRODUCTION

The offer of healthy foods for individuals in school life stage is essential to favor adequate growth and development. Students in Brazilian public schools have the guaranteed right of access to food in the school environment through the National School Feeding Program (PNAE). The program comprises steps since selection and acquisition of food, until preparation and provision of meals in the public school system in Brazil (Law No. 11,947 of June 16, 2009).

The school age range covers the period of growth and physiological development, as well as the construction of the individual's identity, something that permeates the formation of eating habits. It is well known that the eating habits of children and adolescents have moved away from what is recommended for healthy eating, with preferences for high-fat or processed foods (Silva, Teixeira & Ferreira, 2014).

Inadequate eating habits, associated with the increasing rate of overweight and obesity in children and adolescents are considered a global health problem (Yang, C. J Wang, Tsai & Wang, 2015). Conditions such as obesity are the main causes of illness and early death worldwide (Swinburn et al., 2019), thus making it essential to discuss the inclusion of healthy meals in the PNAE, reasserting the need to consume these nutrients, especially at school age.

Flavonoids are bioactive compounds of nutritional importance, mainly for the prevention and/or combat of chronic Noncommunicable diseases (NCDs) (Pacheco, Peraza & Pinto, 2021). They can be found in abundance exclusively in the plant kingdom, within fruits and vegetables as the main food sources (Hamerski, Rezende & Silva, 2013). Banana, apple, cocoa and kiwi, white, green and black teas are considered good sources of flavonoids (Chen, Fan, Wu, Li & Guo, 2019). Considering the wide social inequity that pervades the country, the accessibility and acquisition of foodstuff with a higher supply of flavonoids by families can be difficult, which can cause harm to health, considering the physiological benefits promoted by these compounds.

In summing the total resources provided for school meals, at all stages, the PNAE reserves a minimum of 30% for the acquisition of food produced exclusively by family farming throughout the national territory. Encouraging the consumption of foodstuffs rich in flavonoids, derived from family farming, since childhood is positive, not only for individual benefit, but it can also contribute to the principles of sustainability, on a much broader scale, by reducing the impacts of agribusiness and the mass production of processed products. Knowing the influence of climate change *in natura* food production and consequently on the population's health, the reflection on food habits and choices becomes an urgent issue (Swinburn et al., 2019).

This article aimed to analyze the nutritional

relevance of including food sources of flavonoids in school meals.

MATERIALS AND METHODS

The present study was characterized as a literature review, based on the exploratory reading of references selected through the following platforms: Scientific Electronic Library Online - SciELO (online library), Public Medline-PubMed (database), in the period of 2011 to 2021 and normative and regulatory documents linked to the Ministry of Education, Ministry of Health and American Dietetic Association, without a pre-established publication period and that were related to the National School Feeding Program (PNAE).

The following descriptors were adopted in Portuguese and English: "flavonoids", "healthy eating", "school feeding", "school food", "PNAE", "National School Feeding Program". The established inclusion criteria were: studies involving the theme flavonoids and/or PNAE published in the period from 2011 to 2021 and normative and regulatory documents linked to the PNAE and/or flavonoids. The exclusion criteria used were: studies that were not made available in full, reviews, interviews, comments, publications outside the established period or that were unrelated to the theme of flavonoids, healthy eating and/or school feeding.

After the search, based on the inclusion and exclusion criteria, each material found was read in pairs, attesting to its suitability. It was included 32 references, 23 publications were selected from scientific platforms, being 9 normative documents and public reports linked to the Ministry of Education, the Ministry of Health and the American Dietetic Association. After reading the included references, the material was grouped into topics, according to the topic addressed, in order to organize the topics to be addressed in the review. The three thematic topics were: PNAE - Conceptualization, historical context and food acquisition; Nutritional situation of schoolchildren in Brazil; and Insertion of flavonoids in school meals.

RESULTS AND DISCUSSION

PNAE - Conceptualization, historical context and food acquisition

Despite the deliberations related to food in previous years, the PNAE only came into existence with this nomenclature in 1979, with the objective of fulfilling a supplementary food demand (15% of nutritional needs) only for preschoolers and schoolchildren with age group between 5-6 years and 7-14 years respectively (Peixinho, 2013).

In 1994, with the enactment of Law nº 8,913, it was possible to identify one of the greatest advances of the program, referring to regionality. This law allowed the management of school meals to take place in a decentralized manner, thus making foodstuffs that

already exist in the school's eating habits. The entire menu planning process, as well as the acquisition of nourishment via a bidding process, which was carried out by a managing body, began to be prepared together with the municipalities in partnership with the State Department of Education. This fact was actually achieved from 1999 onwards, with the change in the method of transferring financial resources from the Federal Government, in which all municipalities, the Federal District and states of the country would start receiving resources for the acquisition of foodstuffs.

The law foresaw the creation of School Feeding Councils, a supervisory and advisory body for the program, which comprised the following members, according to the National Fund for the Development of Education: the participation of two representatives of education workers' and students' entities, one representative of the executive branch, two representatives of parents of students and two representatives of organized civil entities.

Even though there were discussions related to the offer of healthy foods, it was only in 2006 that the presence of a nutritionist became a requirement as a technical manager (RT) of the PNAE. From 2009 onwards, the PNAE began to serve the entire public network of basic education and youth and adults, through the enactment of Law No. 11,947. The law reasserted the need to offer healthy, varied and safe food, always respecting regional and cultural aspects, in addition to the inclusion of food and nutrition education in learning strategies, reserving the acquisition of a minimum of 30% of food supplied by family farming.

All program management was carried out centrally, so the food acquisition process was carried out by a managing office. Law No. 11,947 of 2009 provided several advances, mainly in relation to the acquisition of foodstuffs. In addition, it enabled the decentralization of program administration and introduced the obligation to use 30% of resources in the acquisition of food from family farming. This law is known for encompassing one of the greatest achievements of the PNAE, reaffirming the concern with healthy eating by schoolchildren and the possibility of contributing to local development.

The administration of the program at the municipal level can occur through three different modalities: 1) Centralized - the Department of Education manages everything since the purchase of foodstuffs till the ways in which products are stored and distributed among school units; 2) Decentralized - resources are transferred directly to schools which are responsible for purchasing the food that will be offered; 3) Semi-centralized - the Department of Education is responsible for the purchase and distribution of non-perishable food among schools and transfers the resources intended for the purchase of perishable food (Santos, Costa & Bandeira, 2016).

In addition to promoting the provision of healthy food, this progress accessed other advantages, since Law

No. 11,947 also provides for the requirement to purchase food locally or regionally. In this way, the financial resources end up being applied in the region itself, contributing to the financial strengthening of family farmers, stimulating local production and consequently, avoiding the need for transport over long distances, thus contributing to the maintenance of environmental quality and reduction of emissions. of gases related to the greenhouse effect (Kroth, Geremia & Mussio, 2020). It is also necessary to consider the support for local development when the flow of what is produced in a locality is encouraged.

Despite the obligation and social, nutritional and environmental relevance, the acquisition of food from family farming is quite difficult, mainly due to the bureaucratic demand in the provision of services. Other factors that represent obstacles to purchasing food from producers are the planning of a menu that differs from local production and the inadequate infrastructure of school environments, associated with loss of interest by some producers and/or often due to a lack of technical training (Kroth et al., 2020).

On November 16th, 2021, the Resolution CD/FNDE No. 6, of May 8th, 2020, was amended increasing the individual family farmer sales limit for school meals from BRL 20,000.00 to BRL 40,000.00 per "DAP" – family member/year. The DAP code means Declaration of Aptitude for PRONAF (free translation) which is an instrument to identify and qualify Family Units of Agricultural Production. This alteration is configured as a strategy to favor the expansion of the individual contribution of farmers in the purchase of food from family farming.

One of the attributions of the nutritionist technically responsible (RT) for PNAE program is to prepare the menu, which should be based *in natura* and minimally processed foods, respecting special nutritional needs, cultural food characteristics, based on sustainability, seasonality and agricultural diversification of the region, meeting all indications described in the program (Resolution No. 6, of May 8th, 2020).

Resolution No. 6 of 2020 explains the minimum frequency that foods classified as "*in natura*" and "minimally processed" must have, including the percentage of nutritional needs these foodstuffs must meet on the menu in order to offer a healthy and balanced diet for schoolchildren. By establishing the number of nourishments, the nutritionist intends to make meals more varied, attractive, increasing the diversity of food sources of nutrients and thereby reducing the monotony of the menu. For example, offering 10 different foodstuffs from this nutrient category, together it should meet 20% of daily nutritional needs. Thus, the total offer of *in natura* or minimally processed foods weekly in the PNAE must follow the following recommendations:

Table 1

Offer of “*In Natura*” and “minimally processed” foodstuffs on PNAE menus.

Minimum frequency to be offered on the menu	Daily nutritional needs met by the menu
10 foodstuffs	20%
14 foodstuffs	30%
23 foodstuffs	70%

Source: Resolution n.º 6, May 8th, 2020.

Foods that should be offered on a limited basis

In regard to food acquisition, 75% of the resources available for it must be allocated to the purchase of “*in natura*” or “minimally processed” foods, a category in

which includes foodstuff that are sources of flavonoids. In this way, their insertion in the program can occur in an easier way and supported by the current legislation.

Table 2

Foods with limited supply in the PNAE.

Foodstuffs	Maximum frequency	School term	Offering period
Meat products	twice	Partial and Full	Monthly
Pickled vegetables and Sweets	once	Partial and Full	Monthly
Sweetened Dairy drinks or with additives	once	Partial	Monthly
Sweetened Dairy drinks or with additives	once	Fulltime	Monthly
Bakery products (cookies, crackers, bread or cake)	twice – thrice	Partial	Weekly
Bakery products (cookies, crackers, bread or cake)	7 times	Fulltime	Weekly
Margarine or vegetable cream	twice	Partial	Monthly
Margarine or vegetable cream	once	Fulltime	Weekly

Source: Resolution n.º 6, May 8th, 2020.

Nutritional situation of schoolchildren in Brazil

The period of life that involves the school life stage is characterized by numerous physiological changes that require adequate nutritional support to favor such transformations. A healthy and varied diet not only contributes to the current period of the student’s life, but it also shapes a mean of promoting health throughout life (Silva et al., 2014).

According to the public report of the Food and Nutrition Surveillance System (SISVAN), in 2010, evaluating the Body Mass Index (BMI) *versus* age ratio, in a total of 2,294,804 individuals in the school life stage evaluated, 77.87% were considered eutrophic, 13.77% were overweight, 3.66% obese and 3.84% were underweight. Moreover, in 2020, following the same evaluation criteria in a total of 3,098,789 evaluated individuals, SISVAN reported that 64.17% were considered eutrophic, 19.77% were overweight, 9.55% obese and 3.89% were underweight (SISVAN, 2020).

After a decade, the number of eutrophic students

decreased considerably and the overweight and obesity categories kept as a growing line in the period, highlighting the importance of discussing healthy eating and eating habits, including in the stages of school life.

A study carried out in a district in the state of Sergipe evaluated the menu provided in municipal school units and found that among the 60 days evaluated, 58.3% of the days analyzed had a total caloric value above the recommended level. Such values contribute to the increase in obesity (Santos & Sottero, 2020). The eating habits of this school age group also corroborate with inadequate nutritional status throughout their lives (Silva et al., 2014).

The PNAE plays an important role in the development of students, considering the influence of the food offered in the school environment for the formation of eating habits.

Therefore, a proper planning of the school menu, prioritizing “*In Natura*” and/or “minimally processed” foods, will directly influence the nutritional status of students, as well as the formation of their eating habits

(SISVAN, 2020).

Insertion of food sources of flavonoids in school meals

Flavonoids are phenolic compounds derived from the secondary metabolism of plants whose main function is to protect against the incidence of ultraviolet rays and the attack of pathogenic microorganisms on plants. Chemically they are characterized as phenolic substances linked through three carbon atoms, constituting a structure called C6-C3-C6. The various classifications within this group are differentiated through the structure of the C3 ring (flavones, flavonols, flavanones, catechins, anthocyanidins and isoflavones) (Pacheco et al., 2021).

They are classified as bioactive substances by virtue of their specific metabolic or physiological action in humans and they are not considered nutrients. Flavonoids are mainly known for their antioxidant power and their anti-inflammatory activity, inhibiting the synthesis of several inflammatory mediators, such as inflammatory cytokines (IL-1 β and IL-6), minimizing the inflammatory response (Chen et al., 2019).

Flavonoids can decrease LDL cholesterol (low-density lipoprotein) concentrations and membrane lipid oxidation, increasing LDL resistance to oxidation, being a preventive method against the development of cardiovascular diseases throughout life and a positive factor on risk of chronic Noncommunicable diseases (NCD) development. Although frequent in adult life, chronic NCDs have alarmingly affected children and adolescents (Cardoso, Leite & Peluzio, 2014).

These phenolic compounds are distributed exclusively among foods of plant origin such as fruits and vegetables as their main sources (Hamerski et al., 2013). Vegetables and fruits in their entirety are classified as *In Natura* nourishment and according to the Food Guide for the Brazilian Population, such foodstuff must be purchased for consumption without undergoing any alteration as crucial components of the basis of human nutrition in all stages of life (Brasil, 2014). Due to their importance, PNAE menus must contain 280g and 520g of fruits and vegetables per student/week, in part-time and full-time school periods respectively (Resolution No. 6, of May 8th, 2020).

A study carried out by Ciochetto, Orlandi and Vieira (2012) pointed to an insufficient consumption of fruits and vegetables by schoolchildren in southern Brazil. This finding only corroborates the need to promote actions that encourage the consumption of these foods by this group. Additionally, the World Health Organization (WHO) indicated that the inadequate consumption of fruits and vegetables is among the ten risk factors that most cause disease and death in the world. The recommended intake is 400g of fruits and vegetables/day (World Health Organization [WHO], 2014).

The increased consumption of fruits and vegetables

is part of the Strategic Action Plan to Combat chronic NCDs in Brazil for the period from 2011 to 2022 (Brasil, 2011). The goal is to increase the consumption recommended by the WHO reached by only 18.2% of the population (2010) to an extent of 24.3% by the end of 2022 (Malta & Silva, 2013).

The introduction of foodstuff rich in bioactive substances in the menus of Food and Nutrition Units (FNU), including schools, has positive effects on the health promotion process, in addition to contributing to the reduction of the risk of developing cardiovascular diseases (Anacleto, Lajolo & Hassimotto, 2019).

An analysis carried out on school menus in Sergipe state showed an average offer of 16.84 mg of flavonoids/100g at lunch, with the greatest contributions coming from the following foods: Soy protein 31.62%; Beans 15.98%; Apple 15.83%; Spinach 12.64%; Green beans 8.03% and Saffron 6.49% (Souza, 2019).

As part of institutional menus offered to beneficiaries in a popular restaurant in São Paulo city, apple was also mentioned as a representative food in terms of flavonoid content along with orange, eggplant and beetroot (Ramirez, Moreira & Oliveira, 2016).

Del Rio et al. (2013) considered that the amount of phenolic compounds varies in each food and the inclusion of different food sources is of paramount importance to contribute to reducing the risk of chronic NCDs.

According to the American Dietetic Association, foodstuff cannot be evaluated only as sources of macro and micronutrients. It is also necessary to evaluate them according to the content of other physiologically active components along with their impact on health promotion (American Dietetic Association [ADA], 2004). It is important the nutritionist as PNAE technical manager (RT), by listing the options of fruits and vegetables included in the menu, consults the available content indexes of flavonoids present in these nourishments, giving preference to those with higher levels. Another strategy is to develop preparations using the most relevant foods in this regard as the main ingredients of the menu composition (Prazeres et al., 2016).

The preparing process of recipes already implemented and consumed by students allows the enrichment of those from a nutritional point of view. Some easily accessible foods are considered good sources of flavonoids, making it possible to include them in the preparations already made at the UAN in the school context: White onion is used in several recipes and can be replaced by red onion, which has a higher amount of flavonoids in its composition, specifically quercetin (Brazilian Food Composition Table [TBCA], 2019). Parsley, oregano and tomato can be used as natural seasonings and add nutritional value, in relation to the amount of bioactive compounds (Anacleto et al., 2019). Fruits such as bananas, apples and oranges, which are generally widely accepted,

can be offered *in natura* or used in creative preparations that encourage consumption, such as pies, cakes, fortified milk and juices, adding higher levels of flavonoids to the preparations.

The inclusion of flavonoids in school meals should involve the participation of food handlers, so that they are aware of the different strategies for incorporating bioactive food ingredients into preparations without jeopardizing the acceptability of the menu prepared by the nutritionist (Fonseca, Pamponet, Prazeres, Lima & Santos, 2017). It is also necessary to reaffirm to them the importance of consuming such compounds to maintain the health of schoolchildren and to replace processed ingredients with foods that are sources of flavonoids.

The addition of *in natura* or minimally processed foods in school meals significantly reduces the consumption of processed foods and, consequently, the risk of developing chronic NCDs. By reducing the supply of processed and/or ultra-processed ingredients that basically comprise a preparation and including *in natura* foods that are sources of flavonoids, the menu offered will not only meet the guidelines indicated in the Food Guide for the Brazilian Population, but will also increase the amount of bioactive substances ingested per meal (Ludwig, 2011).

Rauber, Campagnolo, Hoffman and Vitolo (2015)

showed that the consumption of processed foods in children aged 3 to 4 years was associated with high levels of total cholesterol and LDL up to 8 years of age, demonstrating its effects on long-term health.

Beside the important desired nutritional aspects, this insertion can contribute to compliance with legislation regarding the increase and diversification of products acquired through family farming since, according to official data until 2017, only 48.5% of Brazilian municipalities reached the minimum 30% of the acquisition provided for by law (National Education Development Fund [FNDE], 2017).

CONCLUSION

Food sources of flavonoids are relevant from a nutritional point of view for schoolchildren in preventing chronic NCDs and can be easily included in the school menu, as they meet all the requirements recommended by the PNAE. By being prioritized on menus, they can directly lead to greater acquisition of food from family farming and reduction in processed foods. The impacts of including food sources of flavonoids in the PNAE are not restricted to health and nutrition, but also include social and environmental aspects.

REFERÊNCIAS

- American Dietetic Association Reports. Position of the American Dietetic Association: functional foods. (2004). *Journal American Dietetic Association*, 104(5), pp. 814-826. doi: 10.1016/j.jada.2004.03.015
- Anacleto, S. L., Lajolo, F. M., Hassimotto, N. M. A. (2019). Estimation of dietary flavonoid intake of the Brazilian population: A comparison between the USDA and Phenol Explorer databases. *Journal of Food Composition and Analysis*, 78, pp. 1-8. doi: 10.1016/j.jfca.2019.01.015
- Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. (2014). Departamento de Atenção Básica. *Guia alimentar para a população brasileira / Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica*. – 2. ed., 1. reimpr. – Brasília: Ministério da Saúde.
- Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. (2011). Departamento de Análise de Situação de Saúde. *Plano de ações estratégicas para o enfrentamento das doenças crônicas não transmissíveis (DCNT) no Brasil 2011-2022*. Brasília: Ministério da Saúde. 154 p. il. (Série B. Textos Básicos de Saúde).
- Cardoso, L. M., Leite, J. P. V., Peluzio, M. C. G. (2011). Efeitos biológicos das antocianinas no processo aterosclerótico. *Revista Colombiana de Ciências Químico Farmacéuticas*, 40(1), pp. 116-138.
- Chen, G. L., Fan, M. X., Wu, J. L., Li, N., Guo, M. Q. (2019). Antioxidant and anti-inflammatory properties of flavonoids from lotus plumule. *Food Chemistry*, 277, p. 706-712. doi: 10.1016/j.foodchem.2018.11.040
- Ciochetto, C. R., Orlandi, S. P., Vieira, M. F. A. (2012). Consumo de frutas e vegetais em escolares da rede pública no Sul do Brasil. *ALAN*, 62, pp. 172-178.
- Del Rio, D., Rodriguez-Mateos, A., Spencer, J. P., Tognolini, M., Borges, G., Crozier, A. (2013). Dietary (poly)phenolics in human health: structures, bioavailability, and evidence of protective effects against chronic diseases. *Antioxid Redox Signalin*, 18, pp. 1818-1892. doi: 10.1089/ars.2012.4581
- Fonseca, K. Z., Pamponet, J. S. S., Prazeres, A. G. M., Lima, C. L. B., Santos, I. P. (2017). Formação para manipuladores de alimentos: conhecimento sobre flavonoides e desenvolvimento de preparações para a alimentação escolar. *Revista ELO – Diálogos em Extensão*, 6(1). doi: 10.21284/elo.v6i1.213

- Fundo Nacional de Desenvolvimento da Educação (FNDE). Programa Nacional de Alimentação Escolar. *Dados da Agricultura Familiar* [Internet]. Recuperado de: <http://www.fnde.gov.br/programas/pnae/pnae-consultas/pnae-dados-da-agricultura-familiar>
- Hamerski, L., Rezende, M. J. C., & Silva, B.V. (2013). Using colors of nature to satisfy consumer desires: natural substances as colorants in the food industry. *Revista Virtual de Química, Sociedade Brasileira de Química*, 5(3), pp. 394-420. doi: 10.5935/1984-6835.20130035
- Kroth, D. C., Geremia, D. S., Mussio, B. R. (2020). National School Feeding Program: A healthy public policy. *Revista Ciência & Saúde Coletiva*, 25(10), pp. 4065- 4076. doi: 10.1590/1413-812320202510.31762018
- Lei n.º 11.947 de 16 de junho de 2009. (2009). Dispõe sobre o atendimento da alimentação escolar e do Programa Dinheiro Direto na Escola aos alunos da educação básica. Diário Oficial da União.
- Lei n.º 8.913 de 12 de julho de 1994. (1994). Dispõe sobre a municipalização da merenda escolar. Diário Oficial da União.
- Ludwig, D. S. Technology, diet, and the burden of chronic disease. (2011). *Jama*, 305(13), pp. 1352-1353. doi: 10.1001/jama.2011.380
- Malta, D. C., & Silva J., J. B. (2013). O plano de ações estratégicas para o enfrentamento das doenças crônicas não transmissíveis no Brasil e a definição das metas globais para o enfrentamento dessas doenças até 2025: uma revisão. *Epidemiologia e Serviços Saúde*, 22(1), p. 151-164.
- Pacheco, F., Peraza, M., & Pinto, I. (2021). Flavonoides: micronutrientes con amplia actividad biológica. *Revista de La Facultad de Medicina*, 44(1), pp.108-122.
- Peixinho, A. M. L. (2013). A Trajetória do Programa Nacional de Alimentação Escolar no Período de 2003-2010: Relato Do Gestor Nacional. *Revista Ciência & Saúde Coletiva*. doi: 10.1590/S1413-81232013000400002
- Prazeres, A. G. M., Lima, C. L. B., Pereira, I., Pamponet, J. S. S., Vieira, R. B., & Fonseca, K. Z. (2016). Desenvolvimento de produtos com elevado teor de flavonoides com matéria-prima da agricultura familiar. In Oliveira, A. M., Vasconcelos, C. B. L., Silva, J. F., Morais, M. A., Dias, N. S., Camacho, R. G. V., Alencar, R. D., Porto, V. C. N. (Orgs.). *Produção orgânica no semiárido*. 1. ed. Mossoró: Edufersa, 3, pp. 448-457.
- Ramirez, I. P. G., Moreira, R. R. D., & Oliveira, J. R. S. (2016). Avaliação de cardápio e alimentos funcionais em restaurante popular. *Segurança Alimentar e Nutricional*, 23(1), pp. 859-867. doi: 10.20396/san.v23i1.8635627
- Rauber, F., Campagnolo, P. D., Hoffman, D. J., & Vitolo, M. R. (2015). Consumption of ultra-processed food products and its effects on children's lipid profiles: a longitudinal study. *Nutrition Metabolism and Cardiovascular Diseases*, 25(1), pp. 116-122. doi: 10.1016/j.numecd.2014.08.001
- Resolução n.º 21, de 16 de novembro de 2021. (2021). Altera a Resolução CD/FNDE n.º 6, de 8 de maio de 2020, que dispõe sobre o atendimento da alimentação escolar aos alunos da educação básica no âmbito do Programa Nacional de Alimentação Escolar – PNAE. Diário Oficial da União.
- Resolução n.º 6, de 8 de maio, de 2020. (2020). Dispõe sobre o atendimento da alimentação escolar aos alunos da educação básica no âmbito do Programa Nacional de Alimentação Escolar – PNAE. Diário Oficial da União. Brasília.
- Santos, R. C., & Sottero, S. C. B. (2020). Assessment of energy adequacy of menus programmed for school meals. *DEMETRA: Alimentação, Nutrição & Saúde*. doi: 10.12957/demetra.2020.46927
- Santos, S. R., Costa, M. S., & Bandeira, G. T. P. (2016). Forms of management of the national school meals program. *Revista de Salud Pública*, 18(2), pp. 311-322. doi: 10.15446/rsap.v18n2.41483
- Silva, J. G., Teixeira, M. L. O., Ferreira, M. A. (2014). Eating during adolescence and its relations with adolescent health. *Texto & Contexto Enfermagem*, 23(4). doi: 10.1590/0104-07072014000570013
- Sisvan. Relatórios do Estado nutricional dos indivíduos acompanhados por período, fase do ciclo da vida e índice. 2010-2020.

- Souza, M. A. (2019). *Caracterização e modelagem estatística de compostos fenólicos em cardápios da rede pública de ensino da educação infantil em Sergipe*. (Dissertação de mestrado em Ciências da Nutrição). Universidade Federal de Sergipe, São Cristóvão, Brasil.
- Swinburn, B. A., Kraak, V. I., Allender, S., Atkins, V. J., Baker, P. I., Bogard, J. R., ... Dietz, W. H. (2019). The Global Syndemic of obesity, undernutrition, and climate change: The Lancet Commission report. *The Lancet*, 393(10173), pp. 791-846. doi: 10.1016/S0140-6736(18)32822-8
- Tabela Brasileira de Composição de Alimentos (TBCA). (2019). *Tabelas complementares – flavonoides*. Universidade de São Paulo (USP). Versão 7.0. São Paulo.
- World Health Organization. (2014). *Global status report on noncommunicable diseases*. Geneva. World Health Organization.
- Yang, Y. T. C., Wang, C. J., Tsai, M. F., & Wang, J. S. (2015). Technology-enhanced game-based team learning for improving intake of food groups and nutritional elements. *Computers & Education*, 88, pp. 143-159. doi: 10.1016/j.compedu.2015.04.008