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Nutritional composition and acceptability of vegetarian and omnivore menus from an early childhood education center in Southeast Brazil: a comparative study

Composição nutricional e aceitabilidade de cardápios vegetarianos e onívoros de um centro de educação infantil do Sudeste brasileiro: um estudo comparativo

Abstract

Introduction: The development and assessment of school meal menus and recipes for children requires special attention regarding nutritional value and sustainability. *Objective*: To compare the nutritional composition and acceptability of vegetarian and omnivorous meals against current dietary recommendations for preschool children. *Methods*: A cross-sectional study was conducted at a private early childhood education institution in Vitória, Espírito Santo. The nutritional compositions of six menu days (three vegetarian and three omnivorous) were analyzed using PlanPNAE and compared with each other and with current legislation. Plate waste and clean leftovers *per capita* were analyzed, with values considered inadequate when ≥45g and ≥25g, respectively. *Results*: The nutritional composition analysis revealed comparable values across all parameters between vegetarian and omnivorous meals. Regarding menu compliance with legislation, both menus met or exceeded recommended values for energy, carbohydrates, proteins, vitamin A, vitamin C, and iron; however, lipid and calcium levels fell below recommendations. Compared to the omnivorous meal, the vegetarian meal showed greater alignment with all reference values. Both plate waste and clean leftovers were inadequate on 33.3% of the days evaluated, on both vegetarian and omnivorous meal days. *Conclusion*: While the vegetarian meal showed lower iron and calcium content compared to the omnivorous option, it more closely aligned with PNAE recommendations. Furthermore, acceptability was similar for both omnivorous and vegetarian menus, with food waste indicators remaining within acceptable ranges during most of the investigated days.

Keywords: School meals. Vegetarian diet. Sustainable development indicators. Waste. Infant feeding

Resumo

Introdução: A elaboração e avaliação de cardápios e receituários para alimentação escolar infantil demanda atenção especial quanto ao caráter nutricional e de sustentabilidade. *Objetivo*: Comparar a composição nutricional e aceitação entre refeições vegetarianas e onívoras, e das mesmas com as recomendações vigentes para pré-escolares. *Métodos*: Estudo transversal realizado em uma instituição privada de educação infantil em Vitória-ES. As composições nutricionais de seis dias de

cardápios (três vegetarianos e três onívoros) foram analisadas pelo PlanPNAE e comparadas entre si e com a legislação vigente. A análise de resto-ingestão e sobra limpa *per capita* foi realizada, sendo inadequados quando ≥45 e ≥25g, respectivamente. ***Resultados***: A comparação da composição nutricional da refeição vegetariana em relação à onívora resultou em valores semelhantes para todos os parâmetros analisados. Quanto à comparação dos cardápios com a legislação, ambos atingiram e/ou ultrapassaram os valores recomendados em relação a energia, carboidrato, proteína, vitamina A, vitamina C e ferro, mas apresentaram valores abaixo da recomendação em relação a lipídios e cálcio. Quando comparada à refeição onívora, a refeição vegetariana demonstrou maior proximidade com todos os valores de referência. O resto-ingestão e a sobra limpa apresentaram inadequação em 33,3% dos dias avaliados, tanto nos dias de refeições vegetarianas quanto nos de onívoras. ***Conclusão****:* A refeição vegetariana demonstra quantidades inferiores de ferro e cálcio quando comparada à onívora, mas apresentou adequação mais próxima à recomendação do PNAE. Além disso, a aceitação de cardápios onívoros e vegetarianos foi semelhante, estando os indicadores de desperdício adequados na maioria dos dias investigados.

Palavras-chave: Alimentação escolar. Dieta vegetariana. Indicadores de Desenvolvimento sustentável. Desperdício. Alimentação infantil.

INTRODUCTION

Childhood is a period marked by discoveries and changes, particularly in lifestyle habits that influence both present and future health and nutrition outcomes. These habits are primarily developed in individuals' family and school environments.[1-4] Schools, in particular, play a fundamental role in promoting autonomy and healthy practices, offering essential foods and nutrients for child growth and development while shaping dietary choices.[5-7]

According to the National School Feeding Program (PNAE), school meals aim to promote access to quality nutrition, which positively impacts development, learning, and academic performance while encouraging healthy and sustainable eating habits.[7]In this context, vegetarian nutrition is recognized by PNAE as one of the possible dietary specifications for students, with guidelines for accommodating vegetarian students regulated through Technical Note No. 1894673/2020.[8]

The Brazilian Vegetarian Society (SociedadeVegetariana Brasileira - SVB) defines vegetarianism as a dietary regimen that excludes all forms of meat from the diet. According to data from the Brazilian Institute of Public Opinion (IBOPE), approximately 14% of the population self-identified as vegetarian in 2018.[9] Beyond health concerns, socioeconomic, cultural, religious, environmental, and sustainability factors are among the primary motivations for adopting this dietary pattern.[10] In a recent literature review, Triches emphasizes the importance of sustainable diets in improving current food systems, while highlighting the need for further progress.[11]

Given this context, there is a growing public interest in vegetarian diets, which is also reflected in educational institutions. Some institutions have increased their investment in plant-based meals and implemented "Meatless Monday," a campaign by the Brazilian Vegetarian Society that promotes one meat-free day per week to encourage reflection on food choices and their impacts on society, health, and the environment.[12]

Changes in school menus should be accompanied by acceptability tests to evaluate the acceptability and feasibility of incorporating these new preparations into school meals.[13,14] There are differences in nutritional and sensory characteristics among preparations, along with factors that need consideration during preparation, such as oxalates present in legumes, which are currently the main available sources of plant protein.[13] Other important indicators of menu acceptability and sustainability include plate waste and leftovers, particularly when introducing or modifying preparations.[14,15] However, there is a scarcity of studies addressing the triad of health, sustainability, and acceptability of school meals.[16]

Therefore, this study aims to compare the nutritional composition and acceptability between vegetarian and omnivorous meals against current recommendations for preschool children in Vitória, Brazil.

METHODS

The study was observational and cross-sectional. It included an assessment of nutritional composition and acceptability of vegetarian and omnivorous meals served during the afternoon shift to 92 preschool children, aged 1-3 years, enrolled in a private early childhood education center in Vitória, Espírito Santo, Brazil.

Data was collected over a three-week period during the first half of 2023, with two days per week alternating between vegetarian and omnivorous menu offerings. It should be noted that daily participant attendance was recorded and included in the analyses, ranging from 73 to 88% of enrolled students.

The menus were previously requested from the facility's nutritionist, and during data collection days, a nutrition undergraduate student monitored the production process and weighed the ingredients used in the daily meals. During the collection days, the menu composition varied from two to five items, with only the protein dish and side dish remaining constant. The selection criteria for the evaluated meals were based on the weekly menu offerings: vegetarian meals were assessed on their designated days (Wednesdays), while omnivorous meals were evaluated either the day before or after the vegetarian option (Tuesdays or Thursdays).

After meal preparation, portions of each food item were weighed in triplicate and standardized to ensure equal quantities for all participants. Plate waste and clean leftovers were weighed after dinner service using a digital scale (Além do Mar Imports®, maximum capacity: 10 kg, precision: 1 g), following Vaz's methodology.[15]

The collected data were recorded on a standardized form documenting the menu, ingredient quantities for each preparation, weights of prepared foods, waste, and the number of students served that day.

After collection, the nutritional composition of each preparation and the complete meal was calculated using ingredient values adjusted for the weight of the distributed meal, number of children served, and portion sizes.

Given educational institutions' legal responsibility to promote adequate and healthy nutrition in the school environment, regardless of their public or private status, and considering PNAE's significance in this context,[17] this study analyzed the Program's recommended parameters for part-time daycare students: energy, carbohydrates, lipids, protein, calcium, iron, vitamin A, and vitamin C.[18] Calculations were performed using PlanPNAE software[19] to estimate the nutritional composition of meals and compare them with PNAE recommendations.[18] The contribution percentage of energy value and each nutrient was estimated using the equation: Contribution % = (Amount of energy or nutrient offered in the menu * 100) / PNAE recommended value.

Per capita plate waste was calculated using the equation: *Per capita* plate waste (g) = (Total weight of plate waste in kg / number of children served) * 1000.[15] *Per capita* clean leftovers were estimated using the formula: *Percapita* clean leftovers (g) = (Total weight of clean leftovers in kg / number of children served) * 1000.[15] Food waste assessment thresholds followed Vaz (2011),[15] with *per capita* plate waste considered inadequate when greater than or equal to 45g, and *per capita* clean leftovers deemed inadequate when greater than or equal to 25g.

The collected data were stored in a database and analyzed using descriptive statistics (frequency, mean, and standard deviation) in *Microsoft Excel*®.

RESULTS

The menus for the observed days at the educational institution are presented in Chart 1. There was no standardization in its structure, and the number of preparations varied from three to five during the evaluated days.

Chart 1. Menu composition on the evaluated days at the private early childhood education center in Vitória, Espírito Santo, Brazil, 2023.

Day	Type of meal	Preparation 1	Preparation 2	Preparation 3	Preparation 4	Preparation 5
1	Vegetarian	White rice	Chickpea and plantain stew (moqueca)			
2	Omnivorous	Cornmeal porridge	Common bean	Chicken and vegetables (potatoes, carrots, chayote)		
3	Vegetarian	Pasta with garlic and olive oil	Textured soy protein meatballs			
4	Omnivorous	White rice	Black beans	Sautéed meat	Sautéed yam	Sautéed collard greens
5	Vegetarian	White rice	Black beans	Lentil patty	Cooked vegetables	
6	Omnivorous	White rice	Kidney beans	Sautéed meat cubes	Seasoned manioc flour with eggs and carrots	Sautéed collard greens

Source: Prepared by the authors (2023)

The portions served on vegetarian menu days were 84g for chickpea and plantain stew (moqueca), 63g for textured soy protein meatballs, and 22g for lentil patties. Conversely, on omnivorous menu days, the menu included chicken with vegetables (78g), sautéed meat (42g), and sautéed meat cubes (27g) (data not shown in table).

Regarding energy and macronutrient content, both menu types showed similar values; however, vegetarian meals contained lower amounts of macronutrients and energy compared to omnivorous menus (Table 1).

It was found that vegetarian meal days more closely aligned with PNAE recommendations for carbohydrates, proteins, and vitamin A compared to omnivorous menus; however, they exceeded vitamin C and iron requirements while falling below recommended levels for lipids and calcium (Table 1).

The analysis of nutrient contribution percentages in vegetarian and omnivorous meals revealed that energy value and protein content exceeded 100% of the recommended daily allowance. Regarding carbohydrates, only one day of the omnivorous menu fell below the recommendation, while lipids showed lower percentages across all days and menu types evaluated (Table 1 and Table 2).

Table 1. Comparison of macronutrient composition of meals with the National School Feeding Program recommendations established by FNDE. Vitória-ES, 2024

NUTRITIONAL COMPOSITION	Day 1 Vegetarian	Day 2 Omnivorous	Day 3 Vegetarian	Day 4 Omnivorous	Day 5 Vegetarian	Day 6 Omnivorous
Energy (kcal)						
Provided	356.8	511.7	339.7	479.9	409.5	446.0
Recommended	304.0	304.0	304.0	304.0	304.0	304.0
Contribution (%)	108.46	168.32	111.74	157.86	134.70	146.71
Carbohydrate (g)						
Provided	73.0	92.0	65.0	83.0	81.0	80.0
Recommended	42-49	42-49	42-49	42-49	42-49	42-49
Contribution (%)	173.8 - 149.0	219.0 - 187.8	154.8 - 132.7	197.6 - 169.4	192.9 - 165.3	190.5 - 163.3
Lipids (g)						
Provided	3.0	7.0	3.0	7.0	3.0	5.0
Recommended	8-12	8-12	8-12	8-12	8-12	8-12
Contribution (%)	37.5 - 25.0	87.5 - 58.3	37.50	87.5 - 58.3	37.5 - 25.0	62.5 - 41.7
Protein (g)						
Provided	10.0	23.0	12.0	21.6	15.0	20.0
Recommended	8-11	8-11	8-11	8-11	8-11	8-11
Contribution (%)	125.0 - 90.9	287.5 - 209.1	150.0 - 109.1	270.0 - 196.4	187.5 - 136.4	250.0 - 181.8

Source: Prepared by the authors (2023).

Regarding micronutrients, iron and calcium levels were lower in vegetarian meals compared to omnivorous ones. In contrast, vitamin A and C levels were higher in vegetarian menus during the first two days compared to omnivorous ones (Table 2).

Iron and vitamin C intake levels exceeded recommended values on all evaluated vegetarian and omnivorous days evaluated, while vitamin A levels were higher than recommended on four days, including two vegetarian and two omnivorous menu days. In contrast, calcium levels were consistently below recommended values across all days and menus analyzed (Table 2).

Table 2. Comparison of micronutrient composition of school meals with the National School Feeding Program recommendations established by FNDE. Vitória-ES, 2023.

NUTRITIONAL COMPOSITION	Day 1 Vegetarian	Day 2 Omnivorous	Day 3 Vegetarian	Day 4 Omnivorous	Day 5 Vegetarian	Day 6 Omnivorous
Iron (mg)						
Provided	2.2	3.2	2.1	3.5	3.3	3.9
Recommended	1.0	1.0	1.0	1.0	1.0	1.0
Contribution (%)	220.0	320.0	210.0	350.0	330.0	390.0
Calcium (mg)						
Provided	46.4	47.4	45.0	62.9	49.9	75.5
Recommended	150.0	150.0	150.0	150.0	150.0	150.0
Contribution (%)	30.9	31.6	30.0	41.9	33.3	50.3
Vitamin A (mcg)						
Provided	84.3	53.9	112.4	63.8	60.5	93.0
Recommended	63.0	63.0	63.0	63.0	63.0	63.0
Contribution (%)	133.8	85.5	178.4	101.3	96.0	147.6
Vitamin C (mg)						
Provided	15.1	7.5	12.6	14.1	8.6	12.8
Recommended	4.0	4.0	4.0	4.0	4.0	4.0
Contribution (%)	377.5	187.5	315.0	352.5	215.0	320.0

Source: Prepared by the authors (2023).

Regarding the waste indicators investigated in this study, *per capita* plate waste was found to be inadequate in 33.3% of days (n=2), while *per capita clean leftovers were inadequate in 66.6% (n=4) of days.* It is noteworthy that the percentage of plate waste and clean leftovers was lower for the vegetarian menu compared to the omnivorous menu. Furthermore, the *per capita* clean waste from vegetarian preparation ranged from 13.9g to 22.9g, corresponding to 55.6% and 91.6%, respectively, of the total recommended waste (Table 3).

Table 3. Total and *per capita* values, in grams, of plate waste (PW) and clean leftovers from total and vegetarian preparations, by menu type in a private early childhood education center. Vitória-ES, 2023.

Day/meal	N of children	Plate waste - Total intake (g)	Plate waste - Per capita intake (g)	Total clean leftovers (g)	Per capita clean leftovers (g)	Vegetarian preparation clean leftover (g)	Per capita vegetarian preparation clean leftover (g)
1 Vegetarian	67	3523.0	52.6	3,450	51.5	1,535	22.91
2 Omnivorous	69	2168.0	31.4	856	12.4	-	-
3 Vegetarian	70	2526.0	36.1	1,878	26.8	1,461	20.87
4 Omnivorous	81	4762.0	58.8	4,138	51.1	-	-
5 Vegetarian	68	2158.0	31.7	1,690	24.9	944	13.88
6 Omnivorous	73	2506.0	34.3	1,960	26.8	-	-

Source: prepared by the author (2023)

DISCUSSION

The results of this study revealed that while vegetarian menus had lower nutritional values compared to omnivorous menus, they more closely aligned with PNAE recommendations.[18] Regarding acceptability measured through food waste indicators, plate waste and clean leftovers were similar between vegetarian

and omnivorous meal days. In this context, it is worth highlighting the role of proper and healthy nutrition in strengthening sustainable food systems.[20]

It is worth noting that differences in nutritional composition between vegetarian and omnivorous meals can stem from various factors, including the quantity and diversity of foods provided, as well as meal planning. Therefore, the Academy of Nutrition and Dietetics[21] recommends adapting vegetarian meals to meet the target population's needs, including children, under qualified professional supervision. This planning ensures that a vegetarian diet can provide adequate nutritional intake.[6,21]

Although no studies have compared the nutritional composition of vegetarian and omnivorous menus in early childhood education settings, the nutritional inadequacy of school meals has been consistently reported in the literature. For instance, Santos and Sottero's study[22] evaluated menus from daycare centers in a large municipality in Sergipe and found energy values exceeding PNAE recommendations, corroborating the findings of the present study.

Martino et al.[23] reported macronutrient intake within acceptable ranges for children aged 1-3 years. However, the authors found calcium and iron values below the recommended daily reference intake for this age group.

A study by Silva-Longo[24] analyzing food consumption in 16 full-time public and philanthropic daycare nurseries in São Paulo State revealed intake levels below recommendations for energy, lipids, calcium, and iron. However, vitamin A, vitamin C, and protein levels were found to be two to five times higher than the recommended daily intake. These data align with some of our findings, as inadequate nutritional composition of meals impacts total daily intake, which may compromise children's growth and development.

The nutritional imbalance in menu composition raises concerns about the need for better combinations of preparations during the planning phase. In this context, Monteiro et al.[13] proposed modifications to the recipes at an ovolactovegetarian school in Franca, São Paulo, aiming to diversify and enhance preparations/meals. The authors found an increase in dietary fiber intake, a reduction in refined sugars, and improved distribution of fruits and vegetables in meals, leading to greater quantity and diversity of micronutrients. The study also incorporated various legume varieties into the menus.

The *Brazilian Dietary Guidelines*[20] recommend regular consumption of legumes as a source of plant protein. Legumes, such as beans, lentils, chickpeas, and peas, are rich in nutrients such as essential amino acids, fiber, vitamins, and minerals. Regular consumption of this food group provides multiple health benefits and helps prevent chronic no communicable diseases. The Guide[20] emphasizes the importance of incorporating at least one serving of legumes daily into the diet, combining them with other foods to obtain complete proteins. Legumes are affordable, sustainable foods that are integral to Brazilian food culture and are recommended as part of a balanced, diverse, and healthy diet.

It is worth emphasizing the importance of using Food Guidelines[20,25] and PNAE legislation[7,18] when developing school menus, even in private institutions, as in the present study. In addition to these documents, it is essential to consider the guidelines from the "Meatless Monday" campaign, proposed by the Brazilian Vegetarian Society, which advocates offering one animal product-free meal per week, highlighting its significance and impact on sustainability.[12]

The values for plate waste and clear leftovers from both evaluated menus were high on certain days. This underscores the critical role of school food service management in addressing food waste through the development and analysis of production process indicators. Several tools can assist in this control, including

standardized recipe cards, which are documents used to standardize ingredient quantities and portion sizes.[18,26]

Menu planning should be prioritized as it represents the starting point of the production process and directly influences all subsequent stages, including procurement of appropriate quantities, standardization of activities, measurement of production indicators, aspects related to meal acceptability, and consequently, food waste in production and consumption.[26]

Important aspects of sustainability are guided by the Sustainable Development Goals, particularly Goal 12 of the National Sustainable Development Goals (SDGs), which focuses on ensuring sustainable production and consumption patterns. Brazil's goal 12.3 aims to halve *per capita* food waste and reduce food losses across production and supply chains by 2030. Brazil's cross-sectoral strategy to reduce food loss and waste aims to combat food loss and waste, guided by the commitment to expand population access to adequate and healthy food. The initiative aims to foster an inclusive process to identify critical points, causes of losses and waste at various levels, as well as potential solutions and degrees of intervention, establishing an action plan that involves all relevant sectors.[27]

Sustainability is an approach that meets basic needs while preserving environmental resources for both current and future generations. The vegetarian lifestyle is grounded in sustainability and environmental stewardship, not supporting the livestock industry—the main contributor to environmental degradation—while embracing practices that minimize waste generation and promote efficient water and energy consumption. Growing vegetables and greens generates fewer environmental impacts, reinforcing evidence that plant-based diets are indeed more sustainable compared to omnivorous ones.[10,12]

Raising awareness about sustainability is essential within the school environment, along with nutritional education and teaching initiatives, as both are crucial tools for reducing negative environmental impact and fostering collective awareness.[28]

The assessment of leftovers and plate waste conducted at a Child Education Center in Mato Grosso do Sul, which served approximately 600 meals daily, yielded similar results to those found in this study.[29] The authors identified that leftovers ranged from 50g to 154g *per capita* and plate waste from 96g to 108g *per capita*, exceeding the values adopted in this study and proposed by Vaz.[15]

A study conducted by Nogueira et al.[30] at a private school in the city of São Paulo highlighted that plate waste and leftover rates may be linked to inadequate portion sizes or the inclusion of poorly accepted preparations into the menu. Similar findings were reported by Barthichoto et al.,[31] who highlighted portion size errors and their direct impact on food waste and oversupply.

Another critical factor is the nutritional and sensory quality of food, which can impact waste levels. Souza et al.[32] reported high levels of food waste and leftovers at a public early childhood center in Vitória-ES, prior to implementing interventions with food service workers.

One of the aims of this study was to compare vegetarian and omnivorous menus. The comparison revealed that the vegetarian meal day, featuring chickpea and plantain stew (moqueca) as the main course, had the highest plate waste and clean leftovers. Although fish stew (moqueca) is a traditional dish from Espírito Santo state and is present in the diet of a large part of the population,[33] the vegetarian version has undergone adaptations. Fish was replaced with chickpeas and plantains were added, which may have caused unfamiliarity among children due to the infrequent consumption or absence of these foods in their regular meals.

Aspects related to children's eating behavior may have contributed to these findings, such as food neophobia—the fear of trying new foods—media influence, and family dynamics, which play a crucial role in children's eating behavior, alongside social, cultural, and economic determinants.[1,34] Late and limited exposure to certain food types, caregiver rigidity, stressful family environments, family income and habits are among the main conditioning factors affecting children's food choices.[35]

The *Dietary Guidelines for Children Under 2 Years* indicates that children need at least 15 different exposures to foods before forming their preferences,[25] even when the preparation is part of the local family and cultural context. Therefore, until food acceptability improves among the target population, high waste levels may remain a persistent issue.

Therefore, food and nutrition education (FNE) interventions positively influence dietary behaviors among school-aged children. Rigon et al.[36] evaluated the impact of FNE on food waste in a study involving elementary school students from two municipal schools in Santa Barbara d'Oeste and Limeira, São Paulo. A reduction of 62% and 43.1%, respectively, was observed in overall food waste at schools. This data emphasizes the importance of implementing FNE initiatives in the short, medium, and long term.

Alongside FNE initiatives, the supervising nutritionist must develop new recipes incorporating vegetables and legumes into menus while evaluating meals' overall nutritional adequacy, ensuring essential nutrient requirements, food safety standards, preparation feasibility, and acceptability testing.[7,10,18]

In essence, the dietitian's role in school food service is crucial for appropriate menu planning, both general and specialized (such as vegetarian options), ensuring proper food combinations and preparations that not only meet but exceed individuals' minimal nutritional requirements.[10,12,13]

The findings of this study provide crucial insights into the acceptability of special menus and diets for pre-school children, which represents a significant contemporary need. However, this study has limitations, including the few days for menu analysis and the restricted evaluation of younger preschool children.

CONCLUSION

Based on these research findings, although the vegetarian meal showed lower nutrient content compared to the omnivorous one, it was more aligned with PNAE guidelines. Therefore, vegetarian diets for school children are feasible when designed by professionals who understand nutrition holistically, taking all relevant factors into account.

Food waste can occur due to multiple factors, ranging from inefficient planning and preparation to population awareness, with the latter being addressable through standardization of meal production processes and implementation of Food and Nutrition Education initiatives. Monitoring plate waste indicators can reflect effective management and promote sustainability, extending to other types of food service establishments. Therefore, food waste monitoring should be prioritized alongside recipe modifications based on acceptability tests and FNE initiatives to ensure modified meals are properly consumed by the target population.

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Contributors

Silva DA participated in the idealization of the study, analysis and interpretation of the data; Participated in the writing, final revision and approval of the manuscript for submission. Santos AAP participated in the conception of the study, collection, analysis and interpretation of data; participated in the writing and final revision of the manuscript for submission.

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