Evaluation of Vegetarian and Vegan Menus Served in University Cafeterias in Terms of Nutritional Value

Bahar YALÇIN ÇELİKTAŞ*, Muazzez GARİPAĞAOĞLU**, İlayda KOÇAK***, Mislina GEYİK****

Abstract

Aim: This study aimed to evaluate the planned lunch menus of two state universities in İzmir and Istanbul that offer vegan and vegetarian options through a theoretical analysis of energy and nutrient content.

Method: In this descriptive study, one-month (29-day) lunch menus obtained from official university websites were analysed for food groups, energy, and nutrient content. Nutrient values were calculated using standard institutional recipes in the Nutrition Information System (BEBIS) 9.0 and compared with the Turkish Nutrition Guide (TUBER) 2022 to assess lunch-level energy and nutrient adequacy. The analysis reflects theoretical values based on planned menus rather than actual served portions or consumption.

Results: The non-vegetarian menu of University B contained higher levels of dietary fibre, vitamins C, B1, B6, B12, iron, zinc, and sodium than University A. In vegetarian menus, University B showed higher values of dietary fibre, vitamins C, B1, B2, B6, and sodium, whereas the vegan menu of University A contained higher energy and fat levels. According to the reference framework used, vegetarian menus appeared to meet most nutrient requirements except vitamin B12, while vitamin B12 and calcium remained below the reference range in vegan menus.

Conclusion: This theoretical analysis suggests that vegetarian menus generally align with lunch-level nutrient recommendations and that appropriately planned vegetarian and vegan menus may provide nutritionally adequate meal options, whereas potential insufficiencies in vitamin B12 and calcium may exist in vegan menus. These findings should be interpreted within the context of planned menus rather than actual consumption.

Keywords: Nutrients, menu planning, vegan, vegetarian.

Özgün Araştırma Makalesi (Original Research Article)
Geliş / Received: 11.11.2024 **Kabul / Accepted:** 30.07.2026
DOI: https://doi.org/10.38079/igusabder.1583037

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Üniversite Yemekhanelerinde Sunulan Vejetaryen ve Vegan Menülerin Besin Değeri Açısından Değerlendirilmesi

Öz

Amaç: Bu çalışmanın amacı, İzmir ve İstanbul'da vegan ve vejetaryen seçenekler sunan iki devlet üniversitesinin planlanmış öğle yemeği menülerini enerji ve besin ögeleri açısından teorik olarak değerlendirmektir.

Yöntem: Tanımlayıcı tipteki bu çalışmada, üniversitelerin resmî internet sitelerinden elde edilen bir aylık (29 günlük) öğle yemeği menüleri besin grupları, enerji ve besin ögeleri açısından analiz edilmiştir. Besin ögesi değerleri, Beslenme Bilgi Sistemi (BEBİS) 9.0 programındaki standart kurum tarifleri kullanılarak hesaplanmış ve öğle öğününe ilişkin enerji ve besin ögesi yeterliliğini değerlendirmek amacıyla Türkiye Beslenme Rehberi (TÜBER) 2022 ile karşılaştırılmıştır. Analiz, gerçek porsiyonlar veya tüketim yerine planlanmış menülere dayalı teorik değerleri yansıtmaktadır. Veriler IBM SPSS yazılımı kullanılarak analiz edilmiştir.

Bulgular: B Üniversitesi'nin vejetaryen olmayan menüsü, A Üniversitesi'ne kıyasla daha yüksek diyet lifi, C, B1, B6, B12 vitaminleri, demir, çinko ve sodyum içermektedir. Vejetaryen menülerde B Üniversitesi'nin diyet lifi, C, B1, B2, B6 vitaminleri ve sodyum değerleri daha yüksek bulunurken, A Üniversitesi'nin vegan menüsünde enerji ve yağ içeriği daha yüksektir. Kullanılan referans çerçevesine göre, vejetaryen menülerin B12 vitamini dışında çoğu besin ögesi açısından gereksinimleri karşıladığı; vegan menülerde ise B12 vitamini ve kalsiyumun referans aralığın altında kaldığı belirlenmiştir.

Sonuç: Bu teorik analiz, vejetaryen menülerin genel olarak öğle öğünü besin ögesi önerileri ile uyumlu olduğunu ve uygun şekilde planlandığında vejetaryen ve vegan menülerin beslenme açısından yeterli öğün seçenekleri sunabileceğini; ancak vegan menülerde B12 vitamini ve kalsiyum açısından potansiyel yetersizlikler bulunabileceğini göstermektedir. Bu bulguların, gerçek tüketimden ziyade planlanmış menüler bağlamında değerlendirilmesi gerekmektedir.

Anahtar Sözcükler: Besin ögesi, menü planlama, vegan, vejetaryen.

Introduction

Vegetarian and vegan diets have been adopted by many cultures and societies throughout history and have been considered safe and nutritious as a long-term diet. These diets have been claimed to have some benefits for human health and have been reported to serve ethical and sustainability principles such as environmental and animal protection[1]. At the same time, vegetarian and vegan diets are considered to be more sustainable than diets based on animal products because they use fewer natural resources and produce lower greenhouse gas emissions[2]. Vegetarianism, which has become increasingly popular in recent years, has types such as vegan where all animal foods are excluded, lacto-vegetarian where only dairy products are consumed except meat-fish and eggs, ovo-vegetarian where only eggs are consumed except meat-fish and milk, lacto-ovo-vegetarian where eggs and dairy products are consumed except meat-fish, and pescetarian where only fish and seafood are consumed instead of meat[3]. In recent years, there has been a significant increase in the number of individuals with vegetarian and vegan eating habits in many countries of the world, especially in developed countries. It

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is estimated that approximately 10% of the general adult population follows a vegetarian diet and 1-2% follows a vegan diet[4].

Scientific studies have shown that vegetarian and vegan diets offer various health benefits such as lower body mass index (BMI), lower blood pressure, and prevention and treatment of non-communicable diseases[5,6]. However, it has been stated that vegetarian diets can negatively affect health due to micronutrient deficiencies, but can positively affect health when well planned[7]. In terms of sustainability, it has been noted that vegetarian and vegan diets have a lower carbon footprint[8] and the ecological footprint as well as the water footprint is three times lower compared to non-vegetarian diets[9].

Today, in parallel with the increasing interest in vegetarian diets, which stand out with their health and environmental benefits, more vegetarian options are offered in the menus of institutions and organisations, including restaurants, factories, banks, schools, and universities[2]. This development is considered an important practice in terms of improving the accessibility and adoption of vegetarian and vegan diets by a wider population. A review of the literature identified a limited number of studies examining the health benefits of vegetarian diets in Türkiye[10,11], but no studies evaluating the nutritional composition of vegetarian and vegan university cafeteria menus were found. Therefore, this study was conducted to evaluate the nutritional values of vegetarian and vegan menus served in university cafeterias. This study aims to contribute to the limited literature by evaluating the adequacy of these menus in terms of energy and nutrient content and by providing evidence that may help improve future menu planning practices.

Material and Methods

This descriptive menu analysis study evaluated one-month (29-day) non-vegetarian, vegetarian, and vegan lunch menus for February 2024 from two public universities in İzmir and Istanbul that offer vegan and vegetarian options. The menus were obtained from the official websites of the universities. These institutions were selected because they were among the limited public universities in Turkey providing complete and accessible monthly lunch menus that included both vegetarian and vegan options. Universities from two different cities were chosen to reflect regional diversity, while only public universities were included to ensure comparability in food service practices. University menus were labelled as A and B. The comparison aimed to explore differences in menu composition across institutional settings rather than provide generalisable results.

The menus were evaluated in terms of food groups, energy, and nutrient content. Energy and nutrient values were calculated using standard institutional recipes in the Nutrition Information System (BEBIS) 9.0 full version. During calculations, meal portions were considered as standard medium portions, yoghurt as 150 mL, and ayran as 200 mL. This study represents a theoretical menu analysis based on planned menus and standard institutional recipes; therefore, it does not reflect actual served portions, recipe variations, plate waste, or student consumption.

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The calculated values were compared with the reference intake ranges for adults specified in the Turkish Nutrition Guide (TUBER) 2022. In order to meet daily energy and nutrient requirements, it is recommended to consume three main meals and 1–3 snacks throughout the day[12]. In collective food service systems, lunch is commonly considered one of the main meals and is expected to provide approximately 2/5 of daily energy and nutrient requirements according to national menu planning guidelines[13]. However, this distribution may vary across institutions and should be interpreted as a planning reference rather than an absolute standard. The adequacy of nutrient intake was classified as <66% insufficient, 66–133% sufficient, and >133% excessive consumption[14].

Data were analysed using IBM SPSS for Windows Version 26.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (mean, standard deviation, and variance) were calculated for all variables. Each daily menu was treated as an independent observation, and mean nutrient values were compared between universities within each menu type using one-way analysis of variance (ANOVA). Prior to analysis, normality was assessed using the Shapiro–Wilk test and homogeneity of variances was evaluated using Levene's test. Statistical significance was accepted as $p<0.05$. Since multiple nutrients were tested separately, the possibility of type I error should be considered when interpreting statistically significant findings. As the data are based on consecutive daily menu plans, results should also be interpreted with caution. Since the study was conducted using publicly available menu data and did not involve human participants, ethics committee approval was not required.

Limitations of the Study

This study has several limitations. First, the analysis was based on planned menus and standard recipes, and therefore reflects theoretical nutrient values rather than actual food served or consumed. Variations in portion sizes, food preparation methods, ingredient substitutions, and plate waste were not accounted for. Second, only lunch menus were evaluated, and total daily dietary intake could not be assessed. Third, the study covered a single one-month menu cycle, limiting the ability to evaluate long-term nutritional adequacy and menu variability. Fourth, the sample was limited to two public universities, which restricts the generalisability of the findings. Finally, as multiple nutrients were analysed separately, there is a potential risk of type I error in the statistical comparisons.

Results

The energy and nutrient contents of the university menus are summarised in Table 1. It was determined that dietary fibre, vitamin C, B1, B6, B12, iron, zinc, and sodium contents of the non-vegetarian menu of University B were significantly higher than those of University A ($p<0.05$). No significant differences were observed for other nutrients. In vegetarian menus, dietary fibre, vitamin C, B1, B2, B6, and sodium values were significantly higher in University B compared to University A ($p<0.05$). In vegan menus, the energy and fat contents of the menu at University A were significantly higher than those of University B ($p<0.05$). As expected, cholesterol was absent in vegan menus and lower in vegetarian menus than in non-vegetarian menus.

Table 1. Energy and nutrient contents of lunch menus served at universities**.**

Energy and Nutrients	**Non-vegetarian Menu**			**Vegetarian Menu**			**Vegan Menu**		
	A X±SD	**B X±SD**	**p***	**A X±SD**	**B X±SD**	**p***	**A X±SD**	**B X±SD**	**p***
Energy (kcal)	935.0±185.9	977.6±190.4	0.393	917.2±206.6	874.4±142.8	0.363	904.1±37.9	804.6±158.8	**0.043**
Carbohydrate (g)	116.8±25.1	114.9±20.4	0.755	119.3±30.6	116.2±22.7	0.666	122.1±26.2	11.4±25.4	0.158
Carbohydrate (%)	51.4±6.5	48.6±5.8	0.082	53.2±6.6	54.3±4.2	0.439	55.6±7.5	57.0±5.4	0.415
Fiber (g)	10.8±3.4	13.6±4.2	**0.010**	13.3±1.2	15.8±5.8	**0.058**	16.0±5.2	16.1±5.6	0.938
Protein (g)	35.9±12.7	39.5±9.4	0.231	27.6±7.5	26.6±6.0	0.604	22.3±5.5	23.0±5.9	0.651
Protein (%)	15.8±5.0	16.6±2.7	0.497	12.3±2.3	12.5±2.6	0.676	10.1±2.3	11.9±2.9	**0.011**
Fat (g)	34.7±11.1	38.6±12.2	0.208	35.5±11.1	32.3±6.9	0.186	35.6±15.1	27.9±7.7	**0.019**
Fat (%)	32.7±5.9	34.7±5.8	0.201	34.5±6.7	33.0±4.9	0.333	34.2±8.5	31.2±6.1	**0.120**
Cholesterol (mg)	121.1±60.9	134.7±75.1	0.451	73.3±56.3	66.4±49.7	0.621	-	-	-
PUFA (g)	6.9±3.7	8.5±4.6	0.163	8.2±4.5	8.6±4.1	0.762	9.4±5.4	8.3±3.5	0.374
Vitamin A (µg)	494.8±272.5	978.7±568.0	**<0.001**	612.2±454.8	941.7±445.8	0.007	890.7±728.6	952.4±440.5	0.698
Vitamin E (mg)	5.07±4.2	6.7±4.7	0.168	7.3±4.6	6.5±4.6	0.508	7.9±5.2	5.7±3.6	0.062
Vitamin C (mg)	39.1±27.6	58.5±30.5	**0.014**	55.5±29.8	78.1±43.0	**0.024**	73.8±38.8	77.7±42.9	0.716
Vitamin B1 (mg)	0.4±0.1	0.5±0.1	**0.001**	0.4±0.1	0.5±0.2	**0.040**	0.5±0.2	0.5±0.2	0.718
Vitamin B2 (mg)	0.6±0.1	0.6±0.2	0.828	0.5±0.1	0.4±0.1	**0.050**	0.3±0.1	0.3±0.1	0.568
Vitamin B6 (mg)	0.6±0.1	0.8±0.2	**<0.001**	0.6±0.1	0.7±0.1	**<0.001**	0.6±0.2	0.7±0.2	0.059
Vitamin B12 (µg)	1.9±1.4	3.3±2.9	**0.036**	0.7±0.5	0.4±0.3	**0.012**	0.0±0.1	0.0±0.1	0.959
Calcium (mg)	344.1±116.9	297.2±111.4	0.124	349.7±108.5	295.4±112.8	0.067	190.9±60.7	204.9±60.6	0.383
Phosphorus (mg)	559.5±144.8	578.4±117.9	0.587	521.39±110.02	483.4±121.7	0.217	411.3±133,3	391.7±116.4	0.554
Magnesium (mg)	139.0±40.4	157.8±41.2	0.084	152.2±38.3	157.9±46.4	0.612	158.3±48.0	148.4±45.4	0.424
Sodium (mg)	1959.5±633.2	2437.2±848.1	**0.018**	1918.2±537.4	2303.9±688.8	**0.021**	1954.0±978.2	1946.5±619.8	0.972
Iron (mg)	5.2±2.1	6.6±2.0	**0.012**	5.6±2.0	5.8±2.0	0.605	6.0±2.1	5.7±2.0	0.528
Zinc (mg)	4.9±1.7	6.4±1.9	**0.004**	4.1±1.2	3.8±0.9	0.490	3.6±1.2	3.5±1.0	0.699

Anova test, $*p<0,05$

The contents of the university menus according to food groups are summarised in Table 2. In non-vegetarian menus, dairy products (milk, yoghurt, and cheese) and animal-based protein sources such as red meat, chicken, fish, and eggs were included. Vegetarian menus contained dairy products, eggs, and higher amounts of legumes compared to non-vegetarian menus. Vegan menus did not include any animal-derived foods and consisted of plant-based food groups.

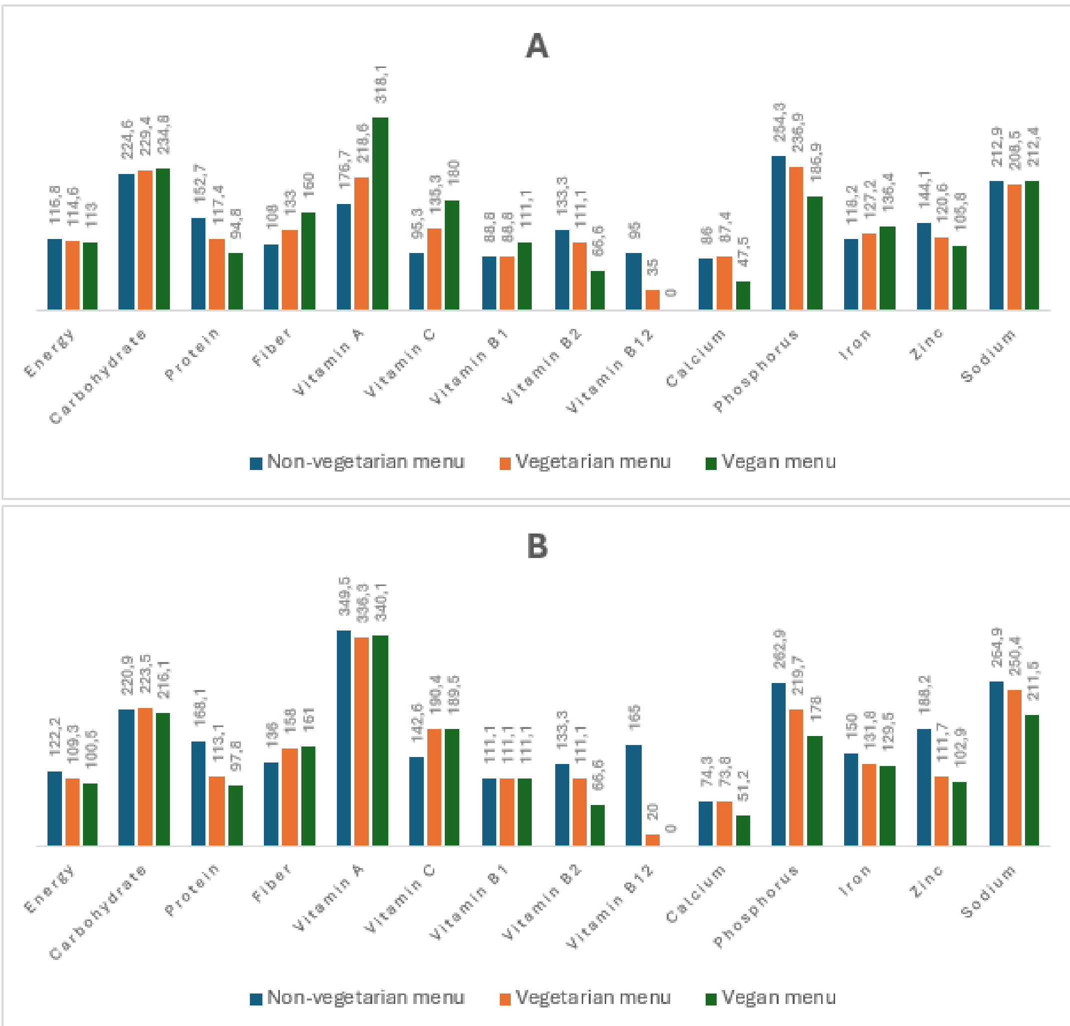
Table 2. Average daily amounts of food groups in planned lunch menus based on standard institutional recipes.

Food Groups	Non-vegetarian Menu		Vegetarian Menu		Vegan Menu	
	A	**B**	**A**	**B**	**A**	**B**
Milk and Products						
Milk (ml)	51.7	21	39	19.7	-	-
Yoghurt (g)	91.5	53.8	80	49.6	-	-
Cheese (g)	3.8	2.7	3.,9	1.7	-	-
Meat Group						
Red meat (g)	27.3	48.4	-	-	-	-
Chicken (g)	17.4	17.2	-	-	-	-
Fish (g)	5.2	5.2	-	-	-	-
Egg (g)	9.4	7.6	5.8	6	-	-
Legumes (g)	31.4	31.6	43	39	41.4	34.5
Bread and Cereals						
Bread (g)	56.5	60.9	54.4	55.6	57.5	52.4
Rice (g)	45.3	53.8	55.8	54.5	50	37.4
Bulgur (g)	7.5	9.5	12	8.4	18.5	8.1
Pasta (g)	22.6	25.2	25.7	25.5	17.1	27.4
Potato (g)	24.1	57.2	21.7	59.8	19.1	58.9
Flour (g)	22.5	13.1	16.9	11.8	9.7	14.6
Vegetables (g)	105.9	172.9	139	224.7	187	233.9
Fruit (g)	29.9	29.7	30.5	13.5	50.9	17.3
Oil (g)	24.5	29.7	27	30.2	32.6	31.4
Sugar (g)	11.9	8.2	11.1	8.4	10.9	8.2

Values are mean daily amounts based on planned menus in BEBIS and do not reflect actual consumption.

Figure 1 presents the percentage of meeting lunch-level nutrient requirements across menu types. According to the reference framework used in this study, most nutrients in non-vegetarian menus fell within the reference range. In vegetarian menus, most nutrients were within the reference range except for vitamin B12. In vegan menus, vitamin B12 and calcium values were below the reference range.

Figure 1. Percentage of lunch-level nutrient requirements met by menu types based on theoretical nutrient calculations.



Classification was defined as <66% (insufficient), 66–133% (adequate), and >133% (excessive).

Discussion

In this study, the nutritional values of one-month planned vegan, vegetarian, and non-vegetarian lunch menus of two state universities were analysed. The findings are based on theoretical calculations derived from standard recipes and therefore reflect menu planning rather than actual consumption. Within the reference framework used in this study, most nutrients in vegetarian menus appeared to fall within the reference range, whereas vitamin B12 in vegetarian menus and both vitamin B12 and calcium in vegan menus remained below the reference range. Energy and protein values were generally within the expected range across all menu types. However, these results do not necessarily reflect long-term dietary intake or nutritional status.

In addition to these findings, the vegetarian and vegan menus demonstrated several favourable nutritional characteristics. They contained higher dietary fibre and lower cholesterol than the non-vegetarian menus, while energy and total protein values generally met the reference range across menu types. These findings suggest that appropriately planned plant-based menus may provide nutritionally adequate lunch options. Nevertheless, a previous study suggested that inadequately planned vegetarian, and particularly vegan, diets may be associated with nutrient inadequacies, including inadequate protein and calcium intake[15]. Although total protein values in the evaluated menus were within the reference range, concerns regarding protein quality and adequate protein intake in vegan diets have been reported[16]. In particular, Allès et al.[17] reported that 27% of individuals following a vegan diet did not achieve the minimum recommended protein intake.

Protein quality was not assessed in this study; therefore, it should also be considered when evaluating the nutritional adequacy of vegan diets. Plant proteins generally have lower digestibility and a less favourable essential amino acid profile than animal proteins, partly because of plant cell walls and antinutritional compounds such as phytates, tannins, enzyme inhibitors, glucosinolates, and isothiocyanates[16,18]. Therefore, potential limitations related to amino acid composition and digestibility should be acknowledged. Importantly, appropriate combinations of plant protein sources, particularly cereals and legumes, can provide a more balanced amino acid profile[18]. Consequently, careful menu planning and dietary diversity may help ensure adequate protein quality in vegan diets.

Calcium values in the evaluated vegan menus remained below the reference range. Although non-vegetarian and vegetarian menus contained similar amounts of dairy products, vegan menus were dairy-free. In line with these findings, a systematic review and meta-analysis reported that vegans have significantly lower calcium intakes than vegetarians and omnivores, whereas calcium intake was similar between vegetarians and non-vegetarians[19]. Lacto-vegetarians are generally not considered at risk of calcium deficiency, whereas vegans tend to have lower calcium intake[20]. Although calcium is found in dairy products and certain plant foods, such as green leafy vegetables, its bioavailability in plant-based diets may be limited by phytate, oxalate, and fibre[21]. Nevertheless, adequate calcium intake can be achieved through careful food selection, calcium-fortified foods, and, when necessary, appropriate supplementation[19]. According to the Institute of Medicine, the recommended calcium intake is 1,000 mg/day for adults aged 19–50 years and 1,200 mg/day for older adults, highlighting the importance of careful calcium planning in vegan diets[22].

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In the study by Selinger et al.[23], vegans were found to have lower vitamin B12 levels compared to non-vegans. In addition, vegans who did not use vitamin B12 supplements had lower levels than those who used them regularly. In the present study, vitamin B12 values in both vegetarian and vegan menus remained below the reference range. However, this finding is not unexpected because vitamin B12 is naturally absent from most plant foods and adequate intake in vegan diets generally depends on fortified foods or supplementation[25]. Vitamin B12 is primarily found in animal-derived foods and plays an essential role in blood formation and nervous system function. Deficiency may lead to megaloblastic anaemia and neurological complications[24]. Therefore, adequate vitamin B12 intake can be achieved in well-planned vegan or plant-based diets through the use of fortified foods and appropriate supplementation[25].

Iron values in the evaluated menus were generally within the reference range, representing another favourable characteristic of the evaluated plant-based menus. Although iron is generally present at adequate levels in vegetarian meals, there are important differences between heme iron and non-heme iron. Heme iron is found only in animal foods and is more readily absorbed than non-heme iron of plant origin[16]. Non-heme iron is found in plant foods such as whole grain cereals, breads, dried beans, legumes, dark green leafy vegetables, dried fruits and nuts[26]. However, due to the absence of heme iron in plant-based diets, iron bioavailability may be lower. Consumption of foods rich in ascorbic acid may enhance the absorption of non-heme iron and help reduce this limitation[16]. In this context, a varied and well-planned vegetarian diet may support adequate iron intake and help minimise the risk of iron deficiency[15].

Conclusion

This study provides a theoretical evaluation of the nutritional composition of planned lunch menus in university cafeterias. Within the reference framework used, vegetarian menus generally met the recommended range for most nutrients, whereas vitamin B12 in vegetarian menus and both vitamin B12 and calcium in vegan menus remained below the reference range. Overall, the findings suggest that appropriately planned vegetarian and vegan lunch menus can provide nutritionally adequate meal options, although careful menu planning remains essential to ensure adequate vitamin B12 and calcium intake. Importantly, these findings are based on the analysis of a single meal (lunch) and do not represent total daily dietary intake. In addition, the potential use of dietary supplements, which is common among individuals following vegan diets, was not considered in this evaluation and may influence overall nutrient adequacy. These findings reflect menu planning rather than actual food consumption and should be interpreted within this context. Improving menu diversity and incorporating nutrient-rich or fortified options, particularly for vitamin B12 and calcium, may help enhance the nutritional adequacy of vegan and vegetarian menus. Future studies including longer evaluation periods and actual food consumption data are needed to better assess overall dietary adequacy.

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