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Environmental Impacts of Menus Served in Two Different Seasons Vegan/Vegetarian and Traditional Turkish Food Restaurants: Comparison of Water Footprint

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Abstract

This research presents a comparative analysis of the water footprint and nutritional values of Vegan and Traditional Turkish restaurants. Conducted in May and July, this study extensively examines the water footprints of both restaurants during these months and the nutritional values of the menus they offer. According to the results of the water footprint analysis, the Vegan restaurant's blue water, grey water, green water, and total water footprint values are significantly lower than those of the Traditional Turkish Restaurant (May: $p<0.001$; July: $p<0.001$). The Traditional Turkish Restaurant's blue water footprint (May: 25.38, July: 41.93) is notably higher than that of the Vegan restaurant (May: 18.26, July: 16.18). Similar trends are observed in the grey water and green water footprint categories. Nutritional value analysis indicates that the energy content of Vegan restaurant menus is lower, but richer in fiber, iron, iodine, and vitamin B12 compared to Traditional Turkish restaurant menus. Particularly, the risk of vitamin B12 deficiency is prominent in Vegan restaurant menus (May: Traditional 8.1 µg, Vegan 0.1 µg; July: Traditional 7.5 µg, Vegan 0.1 µg). In conclusion, this study emphasizes the importance of eco-friendly practices and healthy eating options in the restaurant industry. Restaurant operators should review their water management strategies and take measures to enrich the nutritional content of vegan menus. Consumers should be informed about eco-friendly dietary choices. Without disclosing restaurant names and highlighting the differences between vegetarian and traditional cuisines, various recommendations have been provided for the sector.

Keywords: Water Footprint, Nutrient Analysis, Vegan Restaurants, Traditional Turkish Cuisine, Sustainability

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INTRODUCTION

Nutrition; being healthy, adequate, affordable, safe, and culturally acceptable is considered culturally acceptable for a balanced nutrition and health status (Fanzo, 2019). Sustainability concept first emerged with the report named "Our Common Future" by the World Commission on Environment and Development (WCED), working under the United Nations, in 1987 (Pekcan, 2019).

Decisions made after sustainable agriculture aim to avoid the excessive use and degradation of natural resources in the concept of sustainable nutrition (Smetena et al., 2019). Sustainable nutrition is a dietary approach that is protective and respectful towards biological diversity and ecosystems, culturally acceptable, accessible, economically fair and cost-effective; nutritionally adequate, safe, and healthy; and aims to optimize natural and human resources (Burlingame and Dernini, 2011). The development of the sustainable nutrition approach has been achieved by incorporating three main components: social, economic, and environmental (Smetena et al., 2019).

In recent years, the importance of this concept has been increasing in our country (Can et al., 2021). The sustainability aspects of sustainable nutrition models in Turkey are outlined in the Turkey Nutrition Guide (TUBER, 2022).

Recommendations:

• Reducing the consumption of animal protein sources, especially red and processed meat,

• Increasing the consumption of vegetables and fruits, • Increasing the consumption of plant-based foods such as legumes, nuts, whole grains, and diet rich in fiber,

• Reducing the consumption of packaged food products, • Minimizing food waste and, if possible, composting leftovers,

• Preferring the consumption of locally and seasonally grown foods (TUBER, 2022).

Various dietary models and preferred foods establish a connection between human health and sustainable environment worldwide. Diverse food policies, measures taken for food safety, and dietary guidelines incorporate approaches that focus on both human health and environmental health; emphasizing sustainable, economic, cultural, and social dimensions. Multiple paths are offered in nutrition to leave a healthy and sustainable environment for future generations (Olgun et al., 2022). In this context, sustainable nutrition dietary models have been developed. These dietary models address both human health and environmental health.

In the year 1842, a general definition of the vegetarian dietary style was introduced. The term "vegetarian" comes from the Latin origin "vegetus," which means healthy and lively (Akyol et al., 2022). The reasons for adopting this dietary pattern vary, ranging from ethical motivations and religious beliefs to environmental and cultural concerns, as well as considerations related to health (Dinu et al., 2017). Vegetarian nutrition excludes the consumption of all types of meat, fish, and seafood (Oussalah et al., 2020). Generally, it is associated with a higher dietary quality compared to non-vegetarian diets (Lee et al., 2020).

Vegetarians face challenges regarding the adequacy of nutrients and potential issues such as anemia, especially related to protein, calcium, iron, zinc, B12 vitamin, and D vitamin levels (Özcan & Baysal, 2016). However, studies have shown that individuals following a vegetarian diet tend to have a greater tendency for weight loss compared to those following a Western-style diet (Wang et al., 2023). Moreover, regular consumption of fruits and vegetables, according to meta-analysis results, is inversely associated with cardiovascular risk (Mcevoy et al., 2012). Clinical nutrition studies investigating the effects of a vegetarian diet on diabetic patients have shown significant reductions in fasting blood sugar and cholesterol levels. Despite these positive aspects, imbalanced vegetarian diets can lead to metabolic disorders and nutritional deficiencies (Özcan and Baysal, 2016).

Vegetarian nutrition is defined as dietary patterns determined by the level of intake of animal-based foods and can be categorized into various subtypes (Lee et al., 2020). The vegetarian diet is divided into five different subtypes. The diet subtypes are illustrated in Figure 1.

In 1847, the Vegetarian Society, established in England, decided not to include semi-, pesco-, and pollo-vegetarianism within the scope of vegetarian diets due to the consumption of animal meat (Tuncay, 2018). Vegetarian nutrition and its types can be adopted by individuals for reasons such as a healthy lifestyle, rapid transformation in the food system, changes in lifestyle, and personal preferences (Sezgin et al., 2023).

Studies have shown that the consumption of processed products is minimized in vegetarian diet types, which are rich in plant-based nutrients. The adoption of vegetarian diets has been associated with a reduced risk of various chronic diseases, including cardiovascular diseases, diabetes, hypertension, cancer, and dementia (Wang et al., 2023). Additionally, for women in both pre- and post-menopausal periods, the implementation of lacto-ovo vegetarianism is recommended for the balanced regulation of lipid levels (Tuncay, 2018).

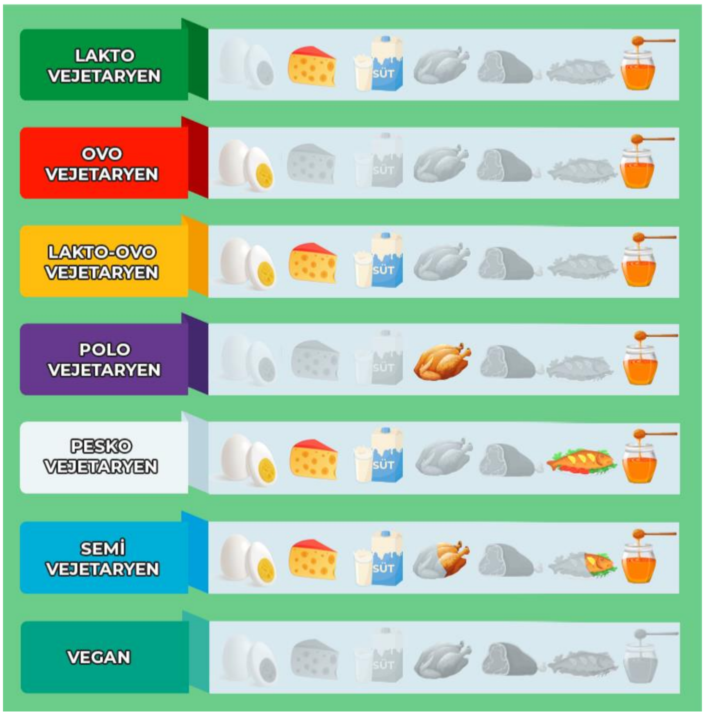

Figure 1. Consumed and Not Consumed Food Groups for Different Types of Vegetarian Diets

Today, there are many dietary guidelines recommending increasing the consumption of plant-based foods while reducing the consumption of animal-based foods. Vegan nutrition plays a significant role in this approach (Dikme, 2023). Vegetarians and vegans are often thought of solely as individuals who do not consume meat. However, this viewpoint is highly inadequate in explaining the underlying social reality of vegetarianism. The word "vegan," meaning to be opposed to the consumption of animal products, was coined by Donald Watson, the founder of the Vegan Society in Turkey, in 1944 (Güler and Çağlayan, 2023). Vegan nutrition, the seventh subtype of vegetarianism, is considered more of a lifestyle and ethical approach than just a dietary type (Akagündüz and Altun, 2023).

Vegans abstain from consuming animal-derived products such as meat, poultry, fish, honey, milk, eggs, yogurt, and other animal-based items (Ucan and Bozok, 2019). Additionally, they avoid using clothing made from animal products like wool, silk, and leather, and are opposed to products tested on animals. Beyond dietary preferences, individuals embracing this lifestyle are referred to as ethical vegans, as their principles extend to all aspects of daily life, distinguishing them from mere dietary vegetarians (Tuncay, 2018). Vegans address their nutritional needs by balancing the intake of soybeans, legumes, and oily seeds as alternative protein sources (İpekci and Toktas, 2021). Ensuring diversity in the consumption of nutrients, especially essential amino acids, is crucial. While animal-based foods provide sufficient essential amino acids, plant-based foods have limited amounts. Hence, vegans need to diversify their meals to meet essential amino acid requirements. Omega-3 fatty acids are found in lower quantities in vegan diets compared to omnivorous diets. Vegans may lack omega-3 fatty acids from fish and have higher omega-6 fatty acids from plant-based oils (TUBER, 2022).

Vegan diets are rich in dietary fiber, magnesium, folate, vitamin C, vitamin E, non-heme iron, and Phytochemicals. However, they are deficient in vitamin D, calcium, zinc, vitamin B12, saturated fat, heme iron, cholesterol, and omega-3 fatty acids (Craig, 2009). Research indicates that women are more prone to iron deficiency anemia than men among vegan individuals (Tatlı, 2022). A well-planned and supplemented plant-based diet, tailored to individual needs and supported by a schedule, can be suitable for individuals at all stages of the life cycle (Wang et al., 2023).

EAT-Lancet Commission, in January 2019, defined a planetary health diet as a healthy dietary pattern aimed at reshaping global food systems for environmental sustainability and improving human health. The commission's goal is to develop a dietary system that preserves the health of individuals and natural resources by 2050. This developed dietary pattern is based on the strongest evidence to achieve global scientific goals for healthy nutrition and sustainable food production. It works within safe boundaries to support the United Nations Sustainable Development Goals.

The planetary health diet primarily consists of abundant plant-based foods such as whole grains, fruits, vegetables, nuts, legumes, and limited amounts of animal-derived foods, refined grains, processed foods, and added sugars. Additionally, the diet is flexible, allowing small amounts of fish, meat, and dairy products as optional choices. In summary, it is a predominantly plant-based diet with the flexibility to include limited amounts of fish, meat, and dairy, depending on personal preferences (Dalile et al., 2022).

Water Footprint

The basic resource that sustains the lives of all living beings is water. However, it is believed that pollution (air, water, environment) and climate change, along with rapid population growth, will render the available water resources insufficient to meet the demand (Chapagain and Hoekstra, 2007). The water footprint is a concept that measures the amount of freshwater required throughout the supply chain to produce a good or service. This approach exists to support decisions regarding various alternative processes and products, aiming for more effective water management, including its usage and allocation (Turan, 2017). Developed by Arjen Hoekstra, this concept integrates both direct water consumption and the water embedded in the products consumed. It has become a valuable tool for assessing the environmental impact of water use and promoting sustainable water management (Mekonnen and Hoekstra, 2011).

Water footprint calculations provide insights into the environmental effects of water use in the production and consumption of goods and services. They consider three key components: blue, green, and grey water footprints.

1. Blue Water Footprint: The blue water footprint accounts for the consumption of freshwater from surface or groundwater sources (Erdogan, 2018). Consumptive water use is identified through four conditions: water evaporation, water embedded in products, water not returning to the same water area (e.g., directed elsewhere or to the ocean), and water not returning during the same period (e.g., withdrawn during a low-water period and returned during a high-water period). While evaporation is often the primary factor, the other conditions are included when relevant (Hoekstra et al., 2009). This metric provides a measure of the amount of consumable freshwater available to humans. The blue water footprint is used in agricultural production, industrial processes, and domestic activities (Oztas and Artar, 2021).

2. Green Water Footprint: The green water footprint represents the volume of rainwater consumed during the production process, particularly in agriculture and forestry (Demir, 2023). It considers the evapotranspiration of total rainwater and rainwater harvested for crops. Distinguishing between blue and green water use is crucial due to the differing impacts of surface and groundwater use compared to rainwater use (Hoekstra et al., 2009).

3. Grey Water Footprint: The grey water footprint serves as an indicator of pollution, demonstrating the volume of ambient water needed to assimilate pollutants (Muratoglu, 2019). This metric is based on water quality standards and estimates the amount of freshwater needed to neutralize or reduce pollution loads (Pegram et al., 2014).

Carbon Footprint

The carbon footprint is another essential indicator for sustainable development, focusing on the ecological impact of carbon dioxide (CO_2) emissions associated with various activities (Ozsoy, 2015). The carbon footprint can be examined under two main categories: personal and corporate (Bekiroglu, 2011). The food footprint of consumers represents their lifestyles and the relationship between their consumption patterns and the environment (Guven and Aysel, 2016). It considers the natural resources used in the production of agricultural, livestock, fishing, and forestry products. The carbon footprint highlights the need for a biologically productive area to offset these emissions, contributing to climate change (Tatlı, 2022).

Sustainable Development Goals

The United Nations has established the Sustainable Development Goals (SDGs) to address global challenges and promote sustainable development. These goals include ensuring health, ensuring food security, eradicating hunger, achieving environmental sustainability, and supporting sustainable agriculture. (Meltzer et al, 2019; Peskircioglu, 2016). Key elements for success in these goals include providing nutritious food for all, reducing non-communicable diseases, and addressing climate change (Gedik, 2020).

To put these principles into action, efforts are required to manage water resources sustainably, reduce carbon footprints, and achieve the targets outlined in the SDGs. By understanding and implementing the concepts of water and carbon footprints, individuals and societies can contribute to a more sustainable and resilient future.

MATERIAL and METHOD

This descriptive study was conducted by obtaining daily food product and raw material inputs twice, in two different seasons, from Vegan Istanbul, a restaurant serving on the European side in Beyoglu district, and Nilce Lezzetler, a restaurant serving traditional Turkish cuisine located in Beykoz district on the Anatolian side of Istanbul. These restaurants were selected based on the researcher's oral discussions, approvals, and accessible opportunities. With the support of the project, written permission was obtained from the restaurants just before starting the study. Subsequently, food raw material inputs were collected from both restaurants on May 20-25, 2023, and July 10-17, 2023. During these dates, the researcher visited the respective restaurants to gather precise information about the inputs. To calculate the water footprint of the obtained food raw materials, the methodology developed by Hoekstra et al was referenced and utilized. Raw materials without a water footprint value were excluded from the calculations.

Calculation of the Water Footprint: Mekonnen and Hoekstra (2011) created average water footprint factors for various foods, including Turkey. According to the data in the study titled 'Evaluation of Different Diet Models in Terms of Carbon and Water Footprint within the Framework of Sustainable Nutrition Concept' conducted by Tatlı (2022), diet models with more animal-sourced foods were found to have higher greenhouse gas emissions and water footprints. The water footprint factors determined for foods produced in Turkey in this study will be used. In studies where the water footprint was calculated, water footprint factors for plant-based foods were determined by calculating the daily water balance of soil crops. The crop coefficient, dependent on the growth stage of the plant, changes over time. Water footprint for animal-sourced foods will be calculated based on the animal's consumption of feed, drinking water, and water for services. Water required for services includes water used to clean the animal's living space, bathe the animal, and perform services necessary for environmental protection. The water footprint of meat products and milk and dairy products will also be calculated based on the average production of the animal. The average water footprint factors of the foods in the menus will be calculated for all menus (a weekly daily menu obtained from both restaurants in two different seasons) by multiplying them with the quantities present in the diet.

Entry of Foods into the System: The energy and nutrient content of the obtained menus were detailed by examining them with the Nutritional Information System (BeBiS) 9 professional version. The daily total energy, carbohydrates, protein, fat, dietary fiber, cholesterol, B12 vitamin, iron, and iodine intake levels of the restaurant menus were determined.

Statistical analyses of the obtained data were conducted using IBM SPSS 25.0 statistical software package. For the analysis of data, descriptive statistical methods were employed, including percentage (%) and number of units (n) for qualitative variables; standard deviation (SD) and arithmetic mean ($\bar{X}$) for quantitative parametric variables; and median (Xmed), lower value, and upper value for quantitative non-parametric variables. The normal distribution of variables was examined through visual methods (histograms and probability plots) and analytical methods (Shapiro-Wilk test).

For correlation analyses to examine relationships between variables, "Pearson" correlation coefficients were calculated for variables showing normal distribution, and "Spearman" correlation coefficients were calculated for those not showing normal distribution. All statistical analyses were evaluated at a confidence interval of 95%, and a significance level of $p<0.05$. Additionally, in the clustering analysis where categorical/qualitative and quantitative variables were examined together, the hierarchical method "Two-Step Cluster" was employed, and importance prediction degrees were calculated. After the preliminary evaluation of the data, decisions were made regarding the use of possible advanced statistical analysis methods.

RESULTS and DISCUSSION

In this part of the study, the average water footprints of traditional and vegan dishes served by Veganİstanbul restaurant, which offers vegan meals, and Nilce Lezzetler Restaurant, which offers traditional Turkish cuisine, during the month of May, are compared.

Table 1. The comparison of water footprints between the vegan restaurant and the traditional restaurant (May, 2023)

Variables	**Type**	**N**	**X̄**	**Ss**	***t***	***p***
Blue water	Traditional		25,38	5,33	15,797	.0000***
	Vegan		18,26	6,55		
Grey water	Traditional		27,11	6,92	12,996	. 0000***
	Vegan		17,64	3,41		
Green water	Traditional		339,55	92,05	12,235	.0000***
	Vegan		139,55	15,90		
Total water (May)	Traditional		392,04	91,48	14,214	.0000***
	Vegan		175,36	21,65		

It was determined that there is a significant difference between the blue, grey, and green water footprints of Veganİstanbul restaurant, which serves vegan meals, and Nilce Lezzetler Restaurant, which serves traditional Turkish cuisine, during the month of May. And along with this It was determined that in May, the restaurant serving traditional dishes had higher blue, grey, and green water footprints compared to the restaurant serving vegan meals.

In this part of the study, the average water footprints of traditional and vegan dishes served by Vegan İstanbul restaurant, which offers vegan meals, and Nilce Lezzetler Restaurant, which offers traditional Turkish cuisine, during the month of July, are compared.

Table 2. The comparison of water footprints between the vegan restaurant and the traditional restaurant (July, 2023).

Variables	**Type**	**N**	**X̄**	**Ss**	***t***	***p***
Blue water	Traditional		41,93	12,49	11,133	.0000***
	Vegan		16,18	5,10		
Grey water	Traditional		33,56	9,60	11,597	.0000***
	Vegan		12,64	1,63		
Green water	Traditional		456,50	72,17	20,979	.0000***
	Vegan		109,18	15,97		
Total water (July)	Traditional		531,99	72,62	24,296	.0000***
	Vegan		138,00	16,57		

It was determined that there is a significant difference between the blue, grey, and green water footprints of Vegan İstanbul restaurant, which serves vegan meals, and Nilce Lezzetler Restaurant, which serves traditional Turkish cuisine, during the month of July. And along with this It was determined that in July, the restaurant serving traditional dishes had higher blue, grey, and green water footprints compared to the restaurant serving vegan meals. So, according to the analyses conducted, it has been determined that the traditional restaurant has a higher water footprint than the vegan restaurant both in May and in July.

Table 3. Vegan and Traditional Restaurants Recommended Daily Allowances (RDA) values for the daily intake (According to the Nutrition Information System (Bebis))

Age/ Gender	19-24 Years of Female				19-24 Years of Male				40-49 Years of Female				40-49 Years of Male			
Months	May		July		May		July		May		July		May		July	
Restaurant Type	TRADITIONAL	Vegan	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN	TRADITIONAL	VEGAN
Energy	48	44	51	48	42	37	43	40	47	46	53	50	39	38	44	41
CHO %	24	30	31	31	21	26	26	26	23	31	32	32	19	26	27	27
Protein %	54	39	62	44	47	33	52	37	52	41	64	46	44	34	53	38
Fats %	92	71	84	81	79	60	70	68	89	74	87	84	74	62	72	70
Fiber %	35	71	50	77	35	72	50	77	35	72	50	77	35	72	50	77
Cholesterol (mg)	91,1	0,1	99,3	0,2	91,1	0,1	99,3	0,2	91,1	0,1	99,3	0,2	91,1	0,1	99,3	0,2
B12	186	4	202	4	186	4	202	4	186	4	202	4	186	4	202	4
Iodıne	42	29	52	29	42	29	47	29	42	29	47	29	42	29	47	29
Iron	42	86	47	90	61	125	76	130	61	125	76	125	61	125	76	130

Nutritional value analysis indicates that the energy content of Vegan restaurant menus is lower, but richer in fiber, iron, iodine, and vitamin B12 compared to Traditional Turkish restaurant menus. Particularly, the risk of vitamin B12 deficiency is prominent in Vegan restaurant menus (May: Traditional 8.1 µg, Vegan 0.1 µg; July: Traditional 7.5 µg, Vegan 0.1 µg).

CONCLUSION

In conclusion, this study emphasizes the importance of eco-friendly practices and healthy eating options in the restaurant industry. Restaurant operators should review their water management strategies and take measures to enrich the nutritional content of vegan menus. Consumers should be informed about eco-friendly dietary choices. Without disclosing restaurant names and highlighting the differences between vegetarian and traditional cuisines, various recommendations have been provided for the sector.

The findings mentioned indicate that vegan nutrition can offer a significant advantage in terms of environmental sustainability. This is because vegan nutrition has the potential to reduce water consumption and resource usage stemming from the consumption of animal products. Particularly, it is known that traditional meat and dairy production have adverse effects not only on water but also on land use, greenhouse gas emissions, and biodiversity. Promoting and adopting vegan meal options can be a significant strategy with the potential to reduce environmental impact. This is important not only for restaurants and individuals but also for consumers to embrace more sustainable and environmentally friendly dietary habits.

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