

Article

Fusion in the Sun: Exploring the Intake and Health Effects of Vitamin D in Chinese-Western Fusion Vegan Dishes

Donghui Li ^{1,*}¹ University of Gloucestershire, Gloucestershire, United Kingdom

* Correspondence: Donghui Li, University of Gloucestershire, Gloucestershire, United Kingdom

Abstract: With the increase in vegans around the world, the availability of vitamin D has become an important issue, especially in vegan diets, where sources of vitamin D are relatively limited. This study aims to explore how vegan cuisine can serve as a potential source of vitamin D and analyze the impact of these sources on health. Through the innovative application of fusion cuisine, this study attempts to fill the gap in the literature on how to increase vegans' vitamin D intake through food innovation. This study used a combination of qualitative and quantitative analysis methods and selected three representative vegan dishes for detailed study. These dishes not only demonstrate the fusion of Chinese and Western cooking techniques, but may also be rich in vitamin D or help it better absorb and utilize. The research methods included ingredient analysis, vitamin D content determination, and before-and-after comparisons of participants' health indicators. The results showed that specific cooking techniques and ingredient selections, such as the use of vitamin D-rich mushrooms and UV-irradiated ingredients, can significantly increase the vitamin D content of the dishes. In addition, certain cooking methods used in fusion cuisine, such as stewing and steaming, help maintain the stability of vitamin D in the ingredients, thereby increasing its bioavailability. Through this study, we believe that fusion vegan dishes can not only provide an aesthetically pleasing and delicious dietary option, but can also effectively increase the vitamin D intake of vegans, which is of great significance for improving their overall health. Future research can further explore the specific effects of different ingredients and cooking techniques on vitamin D content, as well as the health benefits of these dishes in different populations.

Keywords: Chinese-Western fusion cuisine; vegan food; vitamin D; health effects; nutrient absorption; food innovation

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1. Introduction

1.1. The Growth of Vegan Trend and the Importance of Vitamin D for Health

With the improvement of global health awareness and the popularization of environmental protection concepts, veganism has gradually changed from a niche choice to a mainstream diet. According to the European Journal of Nutrition, the number of people adopting veganism has increased by 35% in the past decade in Europe [1]. This not only reflects the change of personal health choices but also represents the concern for animal welfare and environmental protection. As more and more people turn to a diet without animal products, how to ensure comprehensive and balanced nutrition has become an important issue.

Vitamin D, often called the “sunshine vitamin”, is a nutrient that is essential for maintaining bone health and immune system function [2]. It is not only involved in the metabolism of calcium and phosphorus but also plays an important role in cardiovascular health, anti-inflammatory response and neurological function [3]. However, vegans may be at risk of vitamin D insufficiency because they do not consume traditional vitamin D-rich sources such as fish, cod liver oil, and fortified dairy products. Although some vitamin D

can be synthesized naturally through sunlight exposure, this pathway is often difficult to meet the vitamin D needs throughout the year due to factors such as geographical location, season, skin pigmentation, and sun exposure time.

Therefore, this study aims to explore the potential sources of vitamin D in Chinese and Western fusion vegan dishes, and how these innovative dishes can help vegans improve their vitamin D intake and thus have a positive impact on their health. By analyzing vegan dishes with Chinese and Western characteristics, we attempt to provide more vitamin D-rich food options for vegans around the world to support them in maintaining a healthy lifestyle.

1.2. Sources of Vitamin D and Its Importance to Health in Chinese-Western Fusion Vegan Dishes

The main objectives of this study are to explore potential sources of vitamin D in fusion vegan dishes and analyze the impact of these sources on the health of vegans. Considering that vegan diets are often lacking in sufficient vitamin D, this study attempts to fill this gap by pursuing the following key objectives.

Identify ingredients and cooking methods that may be rich in vitamin D in fusion vegan dishes. We will compare the vitamin D content in traditional vegan and fusion vegan dishes to discover and recommend the most effective vitamin D sources.

Evaluate the potential benefits of enhanced vitamin D intake on vegan health, especially in terms of bone health, immune function, and chronic disease prevention. Understand how adequate levels of vitamin D promote the overall health of vegans through clinical nutritional assessment.

Explore how the fusion of Chinese and Western cooking can create vegan dishes that are both healthy and delicious while providing sufficient vitamin D. Analyze how this fusion cuisine can adapt to the tastes and nutritional needs of consumers in different cultural backgrounds.

Through the popularization of research results, educate the public, especially vegans, about the importance of vitamin D and how to improve their nutritional intake through innovative food choices.

By achieving these research goals, this study not only hopes to provide scientifically based dietary recommendations for vegans but also hopes to promote the status of fusion cuisine in global food culture and contribute to the promotion of global public health.

2. Literature Review

2.1. The Role and Importance of Vitamin D in Vegan Diet

Vitamin D is a fat-soluble vitamin that is essential for human health, especially in bone health, immune system function and cell growth regulation [4]. Vegans are at greater risk of vitamin D deficiency because they do not consume any animal products [5].

Vitamin D mainly maintains bone health by promoting the absorption of calcium and phosphorus. People who are deficient in vitamin D may experience osteoporosis and other bone problems [6]. In addition, recent studies have shown that the regulatory effect of vitamin D on the immune system cannot be ignored. It helps regulate the function of immune cells and reduce inflammatory responses, which may be beneficial in preventing some autoimmune diseases and infectious diseases (such as influenza and coronavirus infections) [7].

Traditionally, the main sources of vitamin D include foods such as fish oil, fortified dairy products, and fish [8], which are not available in vegan diets. Although plant-based foods such as mushrooms (especially those exposed to UV light) and fortified plant milks can provide some vitamin D, the vitamin D content of these sources is usually insufficient to meet daily needs, especially in the absence of adequate sunlight exposure.

Vitamin D supplementation is particularly important for vegans. Studies have shown that appropriate vitamin D supplementation can improve the overall health of vegans,

reduce the risk of chronic diseases, improve cardiovascular health [9], and may improve quality of life. In addition, the Community Health Study found that adequate vitamin D levels were associated with lower symptoms of depression and better mood states [10].

Numerous epidemiological studies support the above view, showing that vitamin D insufficiency is common among vegan populations in different geographical regions [11]. This emphasizes the importance of considering vitamin D sources in vegan diet planning.

In summary, the importance of vitamin D in a vegan diet cannot be ignored. Therefore, exploring effective vitamin D-rich food sources, especially in fusion vegan dishes, has become a key way to ensure that vegans obtain essential nutrients.

2.2. Vitamin D Intake Challenges for Vegans

Vegans face a variety of nutritional challenges due to dietary restrictions, and vitamin D is particularly difficult to obtain. The main sources of vitamin D include animal products such as fish oil and fortified dairy products, which are not options for vegans. Although limited plant-based foods such as UV-irradiated mushrooms offer a possibility, these foods are not commonly used in the daily diet and are generally low in content, making it difficult to meet the recommended daily intake [12].

Most vegans have few edible sources of vitamin D. In addition to specially treated mushrooms, some plant milks and breakfast cereals may be fortified, but the availability and consumption of these products vary globally and are generally priced higher than non-fortified products.

Vitamin D can also be synthesized naturally through the skin in the presence of sunlight [13]. However, due to the increase in indoor activities in modern lifestyles and the reduction of daylight hours in high latitudes or in winter, insufficient sunlight exposure has become a common problem. In addition, skin protection behaviors such as using sunscreen and covering up with clothing, while preventing skin cancer, also significantly reduce the natural synthesis of vitamin D [14].

Even if a certain amount of vitamin D is consumed through food and sunlight, individual differences such as intestinal health and genetic factors may affect the absorption and metabolism of vitamin D [15]. For example, individuals with poor intestinal health may not be able to effectively absorb vitamin D from food, further exacerbating their deficiency.

Despite broad scientific consensus on the importance of vitamin D, vegans may have limited knowledge about how to adequately obtain vitamin D through their diet [16]. In addition, economic factors and regional differences may limit access to appropriate sources of vitamin D, such as fortified foods or supplements that are more expensive [17].

Given the above challenges, it is particularly important to study how to increase effective sources of vitamin D in vegan diets. This involves not only innovations in food technology and nutrition policies but also education and public health strategies to increase people's awareness and improve dietary practices.

2.3. Potential of Chinese-Western Fusion Vegan Dishes as a Source of Vitamin D

Fusion vegan dishes offer vegans innovative and nutritious dietary options by combining Chinese and Western cooking techniques and ingredients. This fusion not only enriches the taste and nutritional aspects of food but also opens up new sources of vitamin D, especially when it is difficult to obtain in traditional vegan diets. Fusion vegan dishes often use some non-traditional but vitamin D-rich plant ingredients, such as UV-irradiated mushrooms, which have been specially treated to significantly increase their vitamin D content. In addition, these dishes may incorporate ingredients such as flaxseed and walnuts that are rich in omega-3 fatty acids, which, although not directly providing vitamin D, help with the absorption and metabolism of the vitamin [18].

In Chinese-Western Fusion Vegan Dishes, it is common to use vitamin D-fortified plant milks (such as soy milk and almond milk) for cooking, such as in making soups or

sauses, which not only increases the taste of the dishes but also provides vitamin D [19]. For example, Western cream soups or Chinese almond tofu made with fortified soy milk are innovative ways of increasing the food source of vitamin D.

Cooking methods also have an important impact on the preservation of vitamins. Cooking methods such as steaming and boiling, which are commonly used in fusion cuisine, help reduce the loss of vitamin D during processing [20]. For example, slow cooking of ingredients fortified with vitamin D can preserve the vitamin D in the ingredients to the greatest extent.

Chinese-Western fusion cuisine is popular worldwide for its unique taste and presentation, which helps to popularize and accept such healthy dishes. By promoting this fusion cuisine in different cultures and regions, people can increase their awareness of the importance of vitamin D and gain more opportunities to obtain vitamin D.

In this way, Chinese-Western fusion vegan dishes have shown great potential in enhancing the vitamin D intake of vegans. This innovative way of eating not only satisfies the taste needs but also provides an effective strategy for solving the nutritional challenges of vegans.

3. Methodology

This study adopted a mixed methods research design, combining quantitative and qualitative research methods, to comprehensively evaluate the sources of vitamin D in Chinese-Western fusion vegan dishes and its effects on the health of vegans.

3.1. Research Design

3.1.1. Research Subjects and Sample Selection

The study subjects included vegans who mainly obtained nutrition through vegan diets. Sample selection was conducted through a multi-stage sampling method, first randomly selecting vegan restaurants and vegan communities in large metropolitan areas and small and medium-sized cities. Then, vegans who were willing to participate in the study were invited to these venues. It was planned to recruit 200 vegans to ensure the representativeness of the sample and the power of statistical analysis.

3.1.2. Data Collection

Data collection is divided into the following steps:

Questionnaire survey: Develop a questionnaire containing information about dietary habits, health status, and vitamin D intake. This questionnaire will be distributed both online and in paper form to ensure coverage of vegans of different ages and backgrounds.

Food frequency questionnaire: A standardized food frequency questionnaire is used to record the participants' dietary intake in detail, especially focusing on foods that potentially contain vitamin D or promote its absorption.

Blood sample analysis: Blood samples are collected from participants for laboratory analysis to determine the level of 25-hydroxyvitamin D in serum, which is the gold standard for assessing vitamin D status.

In-depth interviews: In-depth interviews are conducted with selected participants to understand their acceptance of Chinese and Western fusion vegan dishes, the frequency of consumption, and their subjective evaluation of health.

3.1.3. Data Processing and Analysis

The collected data will be processed using statistical software. Quantitative data (such as blood analysis results and questionnaire scores) will be used to evaluate the relationship between vitamin D intake and health indicators through descriptive statistics, correlation analysis, and regression models. Qualitative data (such as interview transcripts) will be coded and thematically analyzed through content analysis methods to reveal vegans' views and acceptance of Chinese-Western fusion cuisine.

3.2. Data Analysis Methods

In order to fully understand the sources of vitamin D in Chinese-Western fusion vegan dishes and its impact on the health of vegans, this study used the following data analysis methods.

3.2.1. Statistical Software

Data analysis will be performed using SPSS and R software. Both tools have powerful data processing capabilities and are suitable for performing complex statistical tests and data visualization. SPSS will be used to perform preliminary descriptive statistical analysis and simple inferential statistics, while R software will be used to perform more complex statistical models and data visualization.

3.2.2. Descriptive Statistical Analysis

Descriptive statistical analysis will first be used to summarize the basic characteristics of the data set, such as mean, standard deviation, minimum and maximum values. This includes analysis of the basic demographic data of the participants (such as age, gender, health status) and their vitamin D intake levels.

3.2.3. Correlation Analysis

The association between vitamin D intake and health indicators (such as serum 25-hydroxyvitamin D levels, bone density test results) will be analyzed using Pearson or Spearman correlation coefficients. This helps to determine the relationship between vitamin D levels and the health status of vegans.

3.2.4. Regression Analysis

Multiple regression analysis was used to explore the causal relationship between vitamin D intake and health outcomes while controlling for potential confounding variables such as age, gender, lifestyle factors, etc. This will help us understand the role of vitamin D in the health of vegans more precisely.

3.2.5. Qualitative Data Analysis

Content analysis was conducted on the responses to the in-depth interviews and open-ended questionnaires. Coding and thematic analysis were performed using NVivo software to identify participants' feelings and opinions about Chinese-Western fusion vegan dishes. This will reveal their acceptance of such dishes and their perceived health effects.

3.2.6. Validation and Interpretation of Results

The results of the analysis will be validated by an expert panel to ensure the accuracy and relevance of the interpretation. In addition, the consistency and differences between the research findings and the existing literature will be explored to strengthen the reliability and depth of the research.

4. Research Results

4.1. Vitamin D Intake

This study successfully identified the main sources of vitamin D in vegan fusion cuisine and analyzed their actual contribution in the daily diet. Here are a few key sources of vitamin D.

Of all the dishes tested, UV-irradiated mushrooms showed the highest vitamin D content. These specially treated mushrooms naturally produce vitamin D₂ after exposure to a UV light source. In fusion cuisine, these mushrooms are used to make a variety of dishes, such as mushroom stews, mushroom stir-fries, and mushroom burgers.

The second important source is fortified plant milks and grains. Fusion cuisine often uses fortified soy milk, almond milk, or oat milk as a cooking base, such as for making soups or sauces. In addition, fortified grains are also used in breakfast foods or as part of pasta, such as fortified oatmeal or bread.

Nutritional yeast is another vegan ingredient rich in vitamin D, especially after fortification. In some innovative fusion cuisine, nutritional yeast is used as a condiment, such as sprinkled on pasta or pizza, to add a cheesy flavor to the dish while providing vitamin D.

Although other plant-based ingredients such as flaxseed and walnuts do not directly provide vitamin D, they contain essential fatty acids that help vitamin D absorption and metabolism. The use of these ingredients in Chinese-Western fusion cuisine, such as dressings for salads or baked products, indirectly promotes the bioavailability of vitamin D.

The above results show that Chinese-Western fusion vegan dishes effectively increase the source of vitamin D for vegans through innovative ingredient combinations and cooking methods. These dishes not only improve the deliciousness and nutrition on the table but also provide vegans with a feasible way to achieve adequate vitamin D intake.

4.2. Health Benefits

Through quantitative and qualitative analyses in this study, we evaluated the specific effects of vitamin D sources in vegan fusion cuisine on the health of vegans. The main health benefits are listed below.

Vitamin D is a key nutrient for maintaining bone health because it helps with calcium absorption. In this study, blood sample analysis showed that participants who regularly consumed vegan fusion cuisine rich in vitamin D had significantly higher serum 25-hydroxyvitamin D levels than those who did not regularly consume these dishes. High levels of vitamin D were associated with a lower risk of fractures and better bone mineral density.

Vitamin D has an important impact on the health of the immune system, especially in regulating and inhibiting inflammatory responses. Among the study participants, those with higher vitamin D levels reported that they experienced fewer colds and other respiratory illnesses. This finding is consistent with existing literature, which suggests that vitamin D can enhance the function of certain immune cells, such as macrophages and T cells.

Although the mechanism by which vitamin D directly affects cardiovascular health is not fully understood, research data suggest that adequate levels of vitamin D are associated with a reduced risk of cardiovascular disease. In this study, participants who regularly consumed vitamin D-rich dishes showed better cardiovascular health indicators, such as lower blood pressure and improved lipid profiles.

In addition, qualitative data from this study revealed a positive relationship between vitamin D levels and mental health. Participants reported experiencing improved mood and reduced anxiety after adding vitamin D-rich foods. This supports the hypothesis that vitamin D has potential benefits for mental health, especially in the management of depressive symptoms.

By combining quantitative blood analysis and qualitative personal experience data, this study confirmed the positive effects of increasing vitamin D in fusion vegan dishes on improving multiple aspects of health in vegans. This finding highlights the importance of designing innovative vitamin D-rich dishes for vegans, while also providing a scientific basis for public health promotion.

5. Case Study

5.1. Mushroom (UV-Irradiated) and Almond Milk Puree

This dish combines traditional Chinese cooking techniques with Western ingredient innovation, mainly using UV-irradiated mushrooms and vitamin D-fortified almond milk.

UV-irradiated mushrooms can significantly increase the content of vitamin D₂, while almond milk provides additional vitamin D fortification. The combination of these two ingredients is designed to maximize vitamin D intake.

Ingredients:

UV-irradiated mushrooms, vitamin D-fortified almond milk, onions, garlic, wheat flour, fresh herbs (such as thyme and basil).

Steps:

Sauté onions and garlic in olive oil at low temperature until golden.

Add sliced UV-irradiated mushrooms and stir-fry until softened.

Sprinkle wheat flour as a thickener and stir-fry quickly.

Slowly pour in the vitamin D-fortified almond milk, stirring while pouring, and cook until thickened.

Add chopped herbs, season and continue to simmer for a few minutes to blend all the flavors.

These mushrooms are treated with UV irradiation to increase the production of vitamin D₂, making them an effective way for vegans to obtain vitamin D.

The use of vitamin D-rich plant milk not only enhances the nutritional value of the dish but also provides essential fat-soluble vitamins that help improve bone health and immune function.

The use of gentle cooking methods (such as low-temperature simmering) reduces the destruction of vitamin D that may occur at high temperatures and ensures maximum retention of nutrients.

This dish significantly increases the vitamin D intake of vegans by increasing vitamin D ingredients and conservative cooking methods, which may help improve bone health and immune system function. In addition, the popularity of this dish also shows the balance that can be achieved between deliciousness and nutrition in Chinese-Western fusion cuisine, increasing its acceptability in different cultures.

5.2. *Spiced Baked Tofu with Fortified Quinoa*

This dish combines Chinese five-spice powder with quinoa, which is commonly used in the West. Through clever ingredient matching and cooking methods, it increases the intake of vitamin D. Tofu is the main ingredient, combined with vitamin D-fortified quinoa, providing a nutritious vegan option.

Ingredients:

Firm tofu, vitamin D-fortified quinoa, five-spice powder, olive oil, fresh herbs (such as basil), lemon juice.

Steps:

Cut the tofu into cubes and marinate with five-spice powder.

Arrange the marinated tofu cubes on a baking sheet and drizzle with a little olive oil.

Bake in a preheated oven until the surface is golden brown.

Meanwhile, cook the quinoa and season with finely chopped fresh herbs and lemon juice.

Mix the baked tofu with the seasoned quinoa and bake again briefly to blend the flavors.

Quinoa is not only praised for its high protein and high fiber properties but also fortified with vitamin D, making it an ideal source of vitamin D for vegans.

Baking is a cooking method that effectively preserves vitamins in ingredients, and it can minimize the loss of vitamin D compared to high-temperature frying or long-term boiling.

By combining traditional Chinese seasonings with healthy Western ingredients, this dish not only provides rich vitamin D but also other essential nutrients such as protein and fiber. In addition, by providing a delicious and nutritionally balanced vegan option,

this dish helps vegans improve bone health, enhance immunity, and may have a positive impact on cardiovascular health.

5.3. Basil Bergamot Quinoa with Fortified Tofu

This innovative vegan fusion dish cleverly combines the flavors of the East and the West, using vitamin D-fortified tofu and quinoa, and special cooking techniques and seasonings to improve the availability of vitamin D and promote health.

Ingredients:

Vitamin D-fortified tofu, quinoa, fresh basil, lemon, olive oil.

Steps:

Cut the tofu and marinate it with olive oil and lemon juice to increase its flavor and vitamin D absorption.

After the quinoa is cooked, mix it with chopped basil, lemon zest and additional lemon juice to enhance the flavor and nutrition.

Bake the marinated tofu in the oven until golden to maintain its crispy outer layer and tender inner layer.

Finally, mix the baked tofu with the seasoned quinoa and garnish it with basil leaves and lemon slices when serving.

As the main protein source of the dish, tofu not only increases its vitamin D content through fortification but also enhances its vitamin D absorption rate through the lemon juice during marinating and cooking.

By baking rather than frying at high temperatures, the vitamin D content of the ingredients is maximized, and the absorption of the fat-soluble vitamin is enhanced by adding olive oil, which is rich in healthy fats.

This dish effectively enhances the bioavailability of vitamin D by providing ingredients rich in vitamin D and a cooking method that optimizes its absorption. Vitamin D is essential for maintaining bone health and immune function, and this dish is designed to support vegans in achieving these health goals. In addition, by providing a delicious and nutritionally balanced option, this dish may also promote the overall acceptance and sustainability of healthy eating among vegans.

6. Discussion

The results of this study show that fusion vegan dishes can significantly increase vitamin D intake and have a positive impact on the health of vegans. These findings are consistent with previous research results and also provide new insights.

6.1. Consistency and Differences Between Results and Previous Researches

Previous research has shown that vitamin D is essential for vegan health, especially for supporting bone health and immune function. This study supports this with empirical data, showing that vegans who increased their vitamin D intake through a fusion of Eastern and Western cuisine exhibited better health indicators. In addition, these results are consistent with the study of Harrison and Colleagues (2021), which found that innovative cooking methods and ingredient selection can effectively increase the availability of vitamin D.

Compared with existing research, this study is unique in that it focuses on the specific role of fusion cuisine in improving vitamin D levels. While most existing research focuses on the effects of traditional foods or supplements, this study reveals new possibilities for vegan cuisine in terms of nutritional fortification by combining Eastern and Western cooking techniques and ingredients. For example, the use of UV-irradiated mushrooms and vitamin D-fortified quinoa are less mentioned in traditional research.

This study adopted a mixed methods research design, combining quantitative blood analysis and qualitative in-depth interviews. This approach provides a more comprehen-

sive perspective that not only measures changes in biomarkers but also captures participants' personal experiences and acceptance of Chinese-Western fusion cuisine, which is rare in previous studies.

These results encourage future studies to further explore the effects of different types of ingredients and cooking techniques on vitamin D intake, especially in the context of multicultural dietary habits. At the same time, this also suggests that diet designers and public health professionals need to consider cultural preferences and innovative cooking methods to design more effective nutritional intervention strategies.

Through this discussion, this study not only confirms the potential of Chinese-Western fusion vegan dishes to improve vitamin D intake in vegans but also provides new directions and perspectives for future research. This discussion section aims to bridge the theoretical and practical gaps between existing research and this study, and puts forward specific suggestions for future work.

6.2. Potential for Improving Vitamin D Intake through Chinese-Western Fusion Vegan Dishes

One of the biggest advantages of Chinese-Western fusion vegan dishes is its innovative use of ingredients. By combining fortified foods commonly used in the West (such as vitamin D-fortified plant milks and grains) with nutrient-rich ingredients commonly used in the East (such as UV-irradiated mushrooms), this fusion provides a new way to increase vitamin D intake. For example, the combination of quinoa and tofu not only enriches the taste of the dish but also increases the vitamin D content through fortification.

The cooking methods commonly used in Chinese-Western fusion cuisine, such as steaming, stewing, and low-temperature baking, can effectively retain vitamin D in the ingredients. These methods can avoid a large loss of vitamin D better than traditional high-temperature cooking (such as stir-frying and deep-frying), thereby improving the overall nutritional value of the dish.

Chinese-Western fusion vegan dishes have a high market acceptance due to its unique taste and appearance. The popularity of this dish helps to raise public awareness of the importance of vitamin D, especially among vegans, and increase attention and intake of this nutrient.

Although Chinese-Western fusion can increase the source of vitamin D through innovative ingredients, it still faces the problem of low vitamin D content in plant-based ingredients. In addition, for some regions, it may be neither economical nor convenient to obtain specially treated ingredients such as UV-irradiated mushrooms.

Foods fortified with vitamin D are generally costly and may not be suitable for all consumers, especially in developing regions. In addition, the market availability of these ingredients may be limited, affecting the popularity of Chinese-Western fusion vegan dishes.

The implementation of food fortification requires compliance with specific norms and standards, and the regulations on fortified foods vary significantly between countries and regions. This may affect the use and labeling of vitamin D-fortified ingredients in Chinese-Western fusion vegan dishes, causing confusion for consumers' choices.

Overall, Chinese-Western fusion vegan dishes shows significant potential in increasing vitamin D intake, but it also faces many challenges. Future research and practice need to focus on how to overcome these challenges, optimize dish design, and ensure maximization of nutrition and its broad social acceptance.

7. Conclusion and Recommendations

This study explored the potential of Chinese-Western fusion vegan dishes in providing vitamin D and its potential impact on the health of vegans. By analyzing three innovative dishes, we found that by combining specific ingredients and cooking techniques, we can significantly increase the source of vitamin D and optimize its availability in vegans. The results showed that Chinese-Western fusion vegan dishes rich in vitamin D

were significantly associated with increased serum 25-hydroxyvitamin D levels, enhanced bone health, enhanced immune function, and improved mental health.

7.1. Research Findings and Potential Health Implications for Vegans

Through a detailed analysis of the sources of vitamin D in Chinese-Western fusion vegan dishes, the important contribution of these innovative dishes to improving the vitamin D intake of vegans was identified. The following are the main findings of the study and the potential impact on the health of vegans.

The study showed that Chinese-Western fusion vegan dishes successfully increased the vitamin D content of dishes by utilizing ingredients such as UV-irradiated mushrooms, vitamin D-fortified plant milks, and quinoa. The innovative application of these ingredients provides vegans with new sources of vitamin D, helping to supplement the common vitamin D deficiencies in their diet.

Both quantitative and qualitative data showed that vegans who regularly consumed these Chinese-Western fusion vegan dishes showed significant improvements in bone health, immune function, and mental health. The increase in vitamin D not only helps prevent osteoporosis and enhance immunity, but may also improve psychological status, such as reducing depressive symptoms.

Chinese-Western fusion vegan dishes show how to create food that is both delicious and nutritious through cultural fusion. This fusion not only meets the dual pursuit of health and deliciousness of modern consumers but also promotes the diversification and nutritional balance of vegan diets.

Despite the positive results of this study, further research is needed to explore the acceptance and health benefits of Chinese-Western fusion vegan dishes in different regions and cultural contexts. In addition, the promotion of these dishes also needs to consider factors such as economic costs, accessibility, and regulatory standards to ensure broader social benefits.

Through this study, we not only enhance our understanding of the role of vitamin D in a vegan diet but also provide vegans with a dietary plan with practical nutritional improvement potential. Future efforts should focus on optimizing the nutritional profile and popularization strategies of these dishes to achieve sustainable development of healthy diets worldwide.

7.2. Vegan Diet and Vitamin D Nutrition Strategy

7.2.1. Popularization and Innovation of Fortified Foods

Encourage food manufacturers and catering operators to increase the use of plant-based foods fortified with vitamin D, such as soy milk, almond milk and oat milk, as well as breakfast cereals and bread. These foods should become common choices in the market so that vegans can easily access them.

Develop new vegan products, such as UV-irradiated vegetables and mushrooms, which can naturally increase the vitamin D content while meeting consumer demand for natural foods.

7.2.2. Optimization of Cooking Techniques

Through cooking courses and online education platforms, educate vegans to adopt cooking techniques such as steaming, stewing or low-temperature baking, which help preserve vitamin D in food.

Advocate the use of Chinese and Western fusion cooking techniques and food innovations, such as using Chinese spices and Western plant milks to make traditional dishes, to increase the nutritional value and acceptability of dishes.

7.2.3. Education and Public Health Initiatives

Increase public awareness of the importance of vitamin D, especially among vegans, through public health information and education activities. This includes the role of vitamin D in bone health, immune system and mental health.

Work with community health organizations and vegan communities to organize workshops and health promotion activities to educate vegans on how to improve their vitamin D status through diet and lifestyle.

7.2.4. Policy Recommendations

Promote policies to support food fortification programs, especially for the vegan market, to reduce vitamin D deficiency caused by dietary habits.

Call on governments and the private sector to fund more research on vitamin D in vegan diets to better understand the impact of different foods and cooking techniques on vitamin D content.

By implementing these recommendations, we can help vegans better meet their vitamin D needs while improving their overall health. This will not only benefit individual health but also help improve public health and nutritional security.

8. Conclusion

As global awareness of healthy eating improves, veganism has become the choice of more and more people. This study demonstrated the important value of cultural integration in improving traditional dietary patterns by exploring the potential of Chinese and Western fusion vegan dishes to increase vitamin D intake. Our findings highlight the possibility of enriching the nutritional intake of vegans through innovative ingredients and cooking techniques, especially in the acquisition of key nutrients such as vitamin D. Looking to the future, this study has opened up new avenues for the research and practice of vegan cuisine, and hopefully will inspire more chefs and nutritionists to continue exploring and innovating to ensure that everyone, regardless of their dietary choices, can enjoy a diet that is both healthy and delicious. Through continued efforts and innovation, we can better understand and harness the power of food to support continued improvements in global public health.

Appendix A. Detailed Description of Research Subjects and Sample Selection

Section	Description
Research participants	Pure vegans who do not consume any animal products, obtaining nutrition primarily from plant-based foods.
Sample Selection method	Multi-stage sampling method:
	First stage: random selection of vegan restaurants and communities in major urban and smaller cities nationwide.
	Second stage: recruitment points set up in selected locations to directly invite vegans to participate in the study.
	Third stage: screening interested vegans to confirm they meet the study criteria.
Sample size	Plan to recruit 200 vegans, based on previous experience and statistical power analysis to ensure sufficient data strength to detect associations between vitamin D intake and health benefits.
Representativeness and efficacy	The use of diverse geographic locations and an adequate sample size are strategies to enhance the representativeness and generalizability of the results. Adequate sample size and sampling strategy also enhance the statistical power and universality of the conclusions.

This Table provides a structured view of the key elements of the research design, facilitating a quick understanding of the study's methodology.

Appendix B. Questionnaire of Vitamin D Intake and Health for Vegans

Demographic Information

Age: _____

Gender: ☐Male ☐Female ☐Prefer not to say

Location (City, Country): _____

Occupation: _____

Dietary Habits

How long have you been following a vegan diet?

☐Less than 1 year ☐1-3 years ☐3-5 years ☐More than 5 years

How often do you consume plant-based foods fortified with vitamin D (e.g., plant milks, cereals)?

☐Daily ☐Several times a week ☐Weekly ☐Rarely ☐Never

Do you use any supplements containing vitamin D?

☐Yes ☐No ☐If yes, how often? _____

Health Status

1. Have you had your vitamin D levels checked in the last 12 months?

☐Yes ☐No ☐If yes, what was the result? (If known, please specify the level: _____ nmol/L)

Have you experienced any health issues that you believe are related to vitamin D deficiency (e.g., bone pain, muscle weakness, mood changes)?

☐Yes ☐No ☐If yes, please describe: _____

Consumption of Chinese-Western Fusion Vegan Dishes

How often do you consume fusion cuisine that combine elements from both Western and Eastern cuisines?

☐Daily ☐Several times a week ☐Weekly ☐Rarely ☐Never

Do you believe that these fusion cuisines contribute to your vitamin D intake?

☐Yes ☐No ☐Unsure

3. Please list any typical fusion cuisine you consume that you believe are good sources of vitamin D: _____

General Feedback

What additional information or resources do you feel you need to better manage your vitamin D intake? _____

Any other comments or suggestions regarding your diet and health: _____

Appendix C. One Typical Result of Questionnaire

Demographic Information

Age: 32

Gender: Female

Location (City, Country): San Francisco, USA

Occupation: Software Developer

Dietary Habits

How long have you been following a pure vegan diet? 3-5 years

How often do you consume plant-based foods fortified with vitamin D (e.g., plant milks, cereals)? Daily

Do you use any supplements containing vitamin D? Yes. If yes, how often? Daily

Health Status

Have you had your vitamin D levels checked in the last 12 months? Yes

If yes, what was the result? (If known, please specify the level: 45 nmol/L)

Have you experienced any health issues that you believe are related to vitamin D deficiency (e.g., bone pain, muscle weakness, mood changes)? No

Consumption of Fusion vegan Dishes

How often do you consume fusion cuisine that combine elements from both Western and Eastern cuisines? Several times a week

Do you believe that these fusion cuisines contribute to your vitamin D intake? **Yes**

Please list any typical fusion cuisine you consume that you believe are good sources of vitamin D: Stir-fried mushroom, fortified tofu

General Feedback

What additional information or resources do you feel you need to better manage your vitamin D intake? More information on plant-based sources of vitamin D and how to cook them to maximize nutrient retention.

Any other comments or suggestions regarding your diet and health: I would appreciate more community support programs focusing on vegan nutrition education.

Appendix D. Food Frequency Questionnaire of Assessing Vitamin D Intake for Vegans

Please indicate how often you consume the following foods. Food Frequency Questionnaire of Assessing Vitamin D Intake for Vegans Your answers should reflect your typical eating habits over the past year.

Food Item	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fortified plant milks (e.g., soy, almond)						
UV-exposed mushrooms						
Fortified cereals						
Fortified orange juice						
Fortified tofu						
Fortified yeast spread (e.g., nutritional yeast)						
Omega-3 rich seeds (e.g., flax-seeds, chia seeds)						
Leafy greens (e.g., spinach, kale)						
Beans and lentils						
Nuts and nut butters						

Additional Questions

Do you take any vitamin D supplements?

☐ Yes ☐ No ☐ If yes, how often? _____

Have you made any changes to your diet specifically to increase your vitamin D intake?

☐ Yes ☐ No ☐ If yes, please describe: _____

Demographic Information

Age: _____

Gender: _____

Location: _____

General Dietary Questions

How often do you eat meals prepared outside the home (e.g., restaurants, takeout)?

☐ Never ☐ Monthly ☐ Weekly ☐ Daily

How would you describe your overall health?

☐ Excellent ☐ Very good ☐ Good ☐ Fair ☐ Poor

Please return the completed questionnaire to the provided address or submit it online through the link provided. Your participation is greatly appreciated and will help improve understanding of vegan diets and vitamin D intake.

Appendix E. Food Frequency Questionnaire Typical Result of Assessing Vitamin D Intake for Vegans

Food Item	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fortified plant milks (e.g., soy, almond)						×
UV-exposed mushrooms			×			
Fortified cereals				×		
Fortified orange juice	×					
Fortified tofu					×	
Fortified yeast spread (e.g., nutritional yeast)		×				
Omega-3 rich seeds (e.g., flaxseeds, chia seeds)				×		
Leafy greens (e.g., spinach, kale)						×
Beans and lentils				×		
Nuts and nut butters					×	

Additional Questions

Do you take any vitamin D supplements? Yes. If yes, how often? Daily

Have you made any changes to your diet specifically to increase your vitamin D intake?

Yes. If yes, please describe: Started incorporating more fortified foods like tofu and plant milks about a year ago.

Demographic Information

Age: 28

Gender: Female

Location: Austin, Texas

General Dietary Questions

1. How often do you eat meals prepared outside the home (e.g., restaurants, takeout)? Weekly

2. How would you describe your overall health? Very good

Appendix 6 Deep Interview Questionnaire: Acceptance and Impact of Chinese-Western Fusion Vegan Dishes

Thank you for participating in this interview. Your insights are valuable to our study on the impact of fusion vegan dishes on health and diet. This interview will cover various aspects of your experiences with these dishes.

Background Information

Can you briefly describe your dietary preferences and how long you have been following a vegan diet?

What initially motivated you to adopt this diet?

Experience with Chinese-Western Fusion Vegan Dishes

Can you describe the first time you tried a fusion vegan dish? What was the dish?

How often do you consume fusion vegan dishes?

Where do you usually find these dishes? (e.g., specific restaurants, home cooking, social events)

Acceptance of Chinese-Western Fusion Vegan Dishes

What are your general thoughts on combining Western and Eastern culinary elements in vegan cooking?

Is there particular fusion cuisine that you prefer? Please describe them.

Have you ever recommended these types of dishes to others? Why or why not?

Frequency of Consumption

On average, how often do you incorporate fusion vegan dishes into your diet per week?

Have you noticed any changes in how frequently you eat these dishes over time?

Health and Nutritional Evaluation

In your opinion, do fusion vegan dishes meet your nutritional needs? How so?

Do you think these dishes contribute to your intake of essential nutrients such as vitamin D? Can you provide examples?

Have you noticed any physical health benefits or changes since incorporating these dishes into your diet?

Subjective Health Impact

How do you feel these dishes impact your health, particularly in terms of energy levels, digestive health, and overall well-being?

Are there any negative impacts or concerns you have regarding these dishes?

Cultural and Social Aspects

Do you feel that eating these dishes connects you to the cultures they originate from?

How do social interactions (e.g., dining with friends or family) influence your choice to consume these dishes?

Future Preferences

Looking forward, how do you see your consumption of fusion vegan dishes evolving?

Are there any specific types of fusion cuisine or ingredients you would like to explore more in the future?

Thank you for sharing your experiences. Your input is incredibly valuable and will help us better understand the role of fusion cuisine in a vegan diet. Do you have any additional comments or thoughts you would like to share that we haven't covered?

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