# Association of Components of the Mediterranean Diet with Food Allergies

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**Abstract.** There is a rising incidence of food allergies, and both children and adults suffer from it. Existing research suggests that avoidance of food allergy relies more on avoiding exposure to food allergens in one's life. However, this method of eliminating food allergy through passive elimination may cause nutritional deficiencies, especially in children during their growth period. On the other hand, most of the food circulating may contain other chemical ingredients that can also cause food allergies. Therefore, this review discusses the effect of the components of the world recognized healthy dietary pattern (Mediterranean Diet) on food allergy, and finds that olive oil, fruits and vegetables, vitamin D (VD) rich foods all have anti-inflammatory and immunomodulatory effects, with the potential to ameliorate food allergy. The aim of this review is to provide new ideas and options for the improvement and prevention of food allergy in the future by exploring the anti-inflammatory and immunomodulatory roles and related mechanisms of the components of the Mediterranean diet. However, there is still a lack of in vivo experiments on humans in related studies, and there is a need to expand the sample size going forward to increase the direct evidence of food allergy amelioration by various components of the Mediterranean diet.

**Keywords:** Food allergy, mediterranean diet, prevention.

## 1. Introduction

Food allergy, a series of immune responses triggered by exposure to specific food allergens, is a common and potentially risky disease. As the number of food allergies in the world increases and food allergies are exposed to the public, understanding the pathogenesis involved is essential to improve and address the problem of food allergies. Food allergy is categorized into food allergy mediated by Immunoglobulin E (IgE) and non-IgE mediated food allergy, and this review focuses on Ig E mediated food allergy. IgE-mediated food allergy is a type I hypersensitivity reaction that occurs after exposure to a specific food. When a food allergen enters the body, the body produces IgE antibodies that attach to basophils or mast cells, sensitizing the body. When the sensitized organism is re-exposed to the same allergen, it stimulates cell activation, and the activated mast cells and basophils release bioactive mediators. The release of these active mediators may lead to an increase in mucus production, vasodilation and vascular permeability, resulting in a variety of allergic symptoms, including the skin, respiratory tract, gastrointestinal tract, cardiovascular and neurological systems. The typical symptoms can involve almost all organ systems, of which the cardiovascular and neurological systems are the most serious symptoms, and may even be a life-threatening situation [1].

In recent years, it has been suggested in relative literature that dietary and nutritional intake can modulate the immune pathways of the organism during the development of allergic diseases, and then influence the allergic outcome. The Mediterranean Diet-one of the most beneficial dietary patterns, has attracted a lot of attention in terms of dietary and nutritional composition. The Mediterranean diet is a nutritional regimen that has a positive modulating effect on various chronic diseases of the organism. The Mediterranean diet regards olive oil as the main source of fat and emphasizes a plant-based diet including a high intake of vegetables, fruits, legumes, grains, and nuts, moderate intake of dairy products, seafood, fish, and eggs, moderate consumption of alcohol (mainly red wine), and controlled intake of red meat [2]. Although new evidence can indicate that in addition to the elimination of disease-causing allergens, making good food choices can also be very helpful in both

avoiding and managing food allergies. more experiments and data are needed to demonstrate that immune-supportive diets can be used as an adjunct to ameliorate food allergies [3].

Therefore, this review discusses the association between various dietary components of the Mediterranean diet and food allergy. The analysis and discussion in this paper provide a reference for future research on improving and treating food allergy.

## 2. Mediterranean Diet Components and Food Allergies

### 2.1. Effect of Olive Oil on Food Allergies

Olive oil has significant anti-inflammatory and immunomodulatory properties and is an essential part of the Mediterranean diet, which is high in monounsaturated fatty acids. It may also be crucial in avoiding and treating food allergies. The nutritional contents of olive oil are shown in Table 1 [4].

**Table 1.** Nutritional Contents of Olive Oil [4]

| Nutritional Contents | Olive Oil Content per 100g |
|---|---|
| Carbohydrates, Fiber | 0-0.2g |
| Protein | 0 |
| Fats | |
| Saturated fatty acids | 14g |
| Unsaturated fatty acids | 86g |
| Vitamins | 0-37mmg |

Yu Ma et al. established a controlled experiment using mice as an animal model to explore the relationship between olive oil and allergic and inflammatory symptoms [5]. The results of this experiment showed that compared with the control group, the experimental group of mice that received an additional dose of olive oil two weeks before sensitization had significantly improved correlations [5]. For example, the spleen index and related inflammatory factor levels were significantly reduced, and the ileocecal villi were closer to normal levels, etc., all showing that olive oil plays a positive role in improving allergic symptoms [5]. Meanwhile, another in vivo animal experimental study showed that by supplementing sensitized mice with olive oil, the experimental researchers found that the intestinal microecological environment in the mice was altered, with an increase in the integrity of their ileocecal villi, partial repair of the losses, an increase in the expression of tight junction proteins (TJ proteins), a growth in the levels of IL-10, a decrease in the number of helper T-cells 2 (Th2), and an alleviation of the allergic symptoms [6]. Therefore, it can be concluded that olive oil not only reverses the atrophy of immune organs induced by certain allergens and reduces the expression of inflammatory factors, but also helps to maintain the immunity of the intestinal mucosa and improves the intestinal micro-ecological environment, which in turn improves food allergy. Despite the fact that relevant studies have shown a positive effect of olive oil on the amelioration of food allergies, there is still a lack of experiments or mechanisms for olive oil to exert relevant anti-allergic effects in humans.

### 2.2. Effect of Fruits and Vegetables on Food Allergies

Vegetables and fruits are an indispensable part of the Mediterranean diet, which is rich in antioxidants and other bioactive substances that improve immune function, and have a high content of phytochemicals, such as phenolics that have been found to have much higher anti-inflammatory activity than other compounds. On the one hand, as a representative component of vegetables and fruit, the immunomodulatory and anti-inflammatory effects of polyphenols have been demonstrated in several studies, and an increasing number of studies have begun to explore the role that polyphenols play in chronic diseases associated with inflammation [7]. Therefore, supplementing with vegetables and fruits opens up the possibility of improving food allergies as well. Currently, relevant mechanisms are being used to explore the relationship between polyphenols and inflammation:

1) polyphenols reduce inflammation by blocking pro-inflammatory cytokines or endotoxin-mediated kinases and transcription factors;

2) polyphenols inhibit inflammation or induce metabolic gene expression by increasing histone deacetylase activity;

3) polyphenols inhibit inflammation through the activation of transcription factors that antagonize chronic inflammation [8].

Relative studies have shown that intervention with polyphenols or polyphenol-rich foods reveals a decrease in the levels of pro-inflammatory cytokines TNF-α and IL-6 (interleukin 6) in mice, in addition to this, the levels of certain enzymes related to inflammation were also decreased in humans or mice through polyphenol intervention, such as COX (cyclooxygenase) in mice, LOX (lipoxygenase), MAPK (mitogen-activated protein kinase), and IKK (κ-kinase inhibitor) in human endothelial cells, and all of these studies above can demonstrate the positive effects of polyphenols on anti-inflammation [7].

On the other hand, polyphenols not only have excellent anti-inflammatory properties, but their improved effect on the intestinal barrier function also has a positive impact on the regulation of food allergies. In food allergy, the intestinal microbiota plays an important role, which not only protects the integrity of the gastrointestinal mucosa by repairing it, thus reducing the probability of food allergy in the organism, but also increases the content of mucins, fecal IgA, and antimicrobial peptides, which prevents the entry of allergens into the corpuscular circulation [9]. The direct or indirect effect of polyphenols on the gut is reflected in its ability to promote the ecological diversity and stability of the microbiota in the gut, inhibit microbial competitors in the gut, as well as reduce the incidence of intestinal inflammation, protect the integrity of the gastrointestinal mucosa, and allow for the rapid recovery of the mucin barrier function [10]. Therefore, based on the abundance of polyphenols in fruits and vegetables and their obvious anti-allergic potential, fruits and vegetables can be regarded as a potential dietary ingredient that can help improve allergies applied in usual nutritional therapy, and provide ideas for subsequent research directions and research methods.

### 2.3. Effect of VD-rich Foods such as Milk on Food Allergies

On the one hand, milk is one of the most common allergens in life. The prevalence of cow's milk allergy in young children is 2-3%, and when allergic children ingest cow's milk, mast cells and eosinophils in the lamina propria of the gastric sinus rapidly degranulate and release mast cell-like trypsin, which interacts with protease-activated receptors co-localized in the nerve fibers of the gastric mucosa, thereby inducing a series of allergic symptoms [11].

On the other hand, milk is rich in VD, and more and more studies are now beginning to explore the link between VD and food allergies. There is indeed a link between VD and food allergies, and the mechanisms are more complex. VD plays a crucial role in microbiome by changing its composition and the function of the barrier consisting of intestinal epithelial cells. And a VD deficiency affects the harmony between pro- and anti-inflammatory activities, which is harmful to the body's ability to fight inflammation. 1,25-Dihydroxy VD is the activated form of VD, when bound to the VD receptor, it leads to changes in the levels of immune cells and immune factors in the body: e.g., a decrease in the levels of inflammatory cytokines, IgE, mast cells, IL-17, and Th17 inhibits the development of allergic mechanisms in the body, while an increase in regulatory T-cells and IL-10 can help to inhibit some of the immune mechanisms and inflammatory responses [12].

It is worth noting that different levels of VD may have different effects on food allergies. Previous studies have shown that VD does exacerbate the risk of food allergy. While a systematic analysis of ten studies in recent years shows that children with VD insufficiency are nearly 70% more likely to develop food allergies (OR: 1.68, 95% CI [1.25-2.27], p-value: 0.001) [13]. Also, in a mice model for studying food allergy, it was demonstrated that VD deficiency exacerbates the effects of food allergy. This suggests that moderate supplementation with VD-rich foods may reduce the risk of food allergy. The above paradox of the effect of VD on food allergy can be explained by the U-shaped

dose-response curve, and supplementation with VD-rich foods needs to be done in moderation, as excess or insufficiency can exacerbate the risk of food allergy [14].

Therefore, when to add milk to the diet, in which way to consume milk, and the amount of milk consumed play a crucial role in preventing and ameliorating food allergy. More relevant data are needed to aid in the design of programs to ameliorate food allergy in subsequent research discussions.

## 3. Strategies for Managing Food Allergy

The commonly accepted view is that strict elimination diet is the only strategy for treating food allergies, but this approach is usually reactive. Thus, how to proactively manage and ameliorate food allergies is a hot topic in current research. The use of immunomodulators for the treatment of food allergy has also been proposed in recent years, but this approach requires further clinical validation [15]. In this review, the prevention and treatment of allergies through immune support diet are proposed, whether it's olive oil, vegetables and fruits, or foods rich in VD from the Mediterranean diet mentioned in this review, they all have a positive effect on the anti-inflammatory response in the body and can help to improve the internal environment of the intestines. Therefore, focusing on the Mediterranean diet by studying the impact and effect of its various components on food allergies, and then analyzing the role of this dietary pattern in food allergy, may help to improve and prevent food allergy.

## 4. Conclusion

Food allergy has been a hot research topic in recent years, and the quantity of people with food allergies has been increasing annually. With the diversification and complexity of dietary structures in our lives, the prevention of food allergy only by avoiding food allergens is no longer very suitable for current lifestyle. Therefore, people's attention has gradually shifted from avoiding food allergens to adjusting dietary intake to prevent and alleviate food allergies, and more and more nutrients and dietary patterns have been found to be associated with improving and preventing food allergies. The Mediterranean Diet is one of the healthiest proven dietary patterns, and whether there is an association between the Mediterranean diet and food allergies needs to be discovered. Available studies have shown that the Mediterranean diet, as an emerging healthy eating pattern, has dietary components that have anti-inflammatory and immunomodulatory effects, and may have a preventive and mitigating effect on food allergies. However, there is still a lack of substantial direct evidence on the impact of a Mediterranean diet on allergies to foods and a large number of in vivo experiments on humans are needed for further validation. Therefore, in future experimental studies, it is necessary to expand the sample size and increase the number of human experiments to further elucidate the immune mechanism of its related dietary components acting on the body, so as to provide a reference method for the improvement and treatment of food allergy in the future.

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