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Extra Virgin Olive Oil:

a highly important nutritional tool for people with diabetes



THE MEDITERRANEAN DIET AND ITS PROTECTIVE POWER

Currently—and for some time now—there is much discussion around the Mediterranean diet and its health benefits. We could say that it has become fashionable, largely due to the growing health burden caused by rising rates of obesity and associated metabolic diseases, such as type 2 diabetes mellitus. However, the first scientific evidence supporting the benefits of the Mediterranean diet is not recent; it dates back to the 1950s. The well-known "Seven Countries Study," led by **Ancel Keys** in 1958, showed that the dietary pattern of Mediterranean countries—rich in fruits, vegetables, grains, olive oil, and fish—reduced deaths from heart disease and increased longevity when compared with other regions of the world such as the United States, the Netherlands, Finland, and Japan (1). The conclusions of this study led Keys to develop the concept of the "**Mediterranean diet**", for which he is now considered the "father" of this dietary pattern. More recent studies—particularly 2 conducted by Spanish researchers, the **PREDIMED** study (2) and the **CORDIOPREV** study (3)—have clearly demonstrated the Mediterranean diet's protective effect against cardiovascular disease, both in healthy individuals and in those with a past medical history of cardiac disease.

IMPORTANCE OF LIPIDS FOR HEALTH

One of the findings that most caught Keys' attention was the high consumption of olive oil in Mediterranean countries. Olive oil consists of 98% triglycerides and 2% of minor components, including vitamins, polyphenols, and other compounds. Keys »

» observed that olive oil was the main lipid source in these populations. Lipids are one of the 3 essential **macronutrients**, along with carbohydrates and proteins. Although lipids—particularly triglycerides (fats)—have traditionally been criticized because of their high caloric content and role in cardiovascular disease, they are essential for the body. Beyond serving as an energy source, they have structural, regulatory, absorptive, and sensory functions.

Of note, not all triglycerides within the lipid group are the same. They are all composed of one glycerol molecule and three fatty acids (hence the name triglycerides), but these fatty acids may be of 3 different types: saturated, monounsaturated, or polyunsaturated, depending on the number of double bonds they contain. There are triglycerides with a predominance of saturated fatty acids, a predominance of **monounsaturated fatty acids, or a predominance of polyunsaturated fatty acids**, and this depends on the type of food from which they originate. Triglycerides rich in saturated fatty acids are generally harmful to health and should be consumed in moderation; they are found in red meats, cured meats, bacon, pork belly, whole-fat dairy products and derivatives, industrial pastries, fast food, cookies, salty snacks, coconut oil, palm oil, and cocoa butter. It is very important for health that dietary triglycerides consist mainly of **monounsaturated and polyunsaturated fatty acids**, as occurs in foods such as olive oil, nuts, and fish.

OLIVE OIL VS VIRGIN OLIVE OIL (VOO) OR EXTRA VIRGIN OLIVE OIL (EVOO): THE ROLE OF BIOPHENOLS

As mentioned earlier, one of the aspects that most impressed the American researcher Ancel Keys when he studied the diet of Mediterranean countries was the high consumption of olive oil. At that time (1950–1960), most of the olive oil consumed in Mediterranean regions—especially in rural areas—was **virgin olive oil (VOO)**, a pure olive juice obtained without chemical processing. During that period, the industry was refining chemical methods for processing olive oil, such as caustic soda neutralization, bleaching, and deodorization. These methods made it possible to use low-quality oils and oils not suitable for consumption,

leading to widespread commercialization of refined olive oil under the label “olive oil,” in contrast to VOO and extra virgin olive oil (EVOO), which do not contain refined oil. Of note, refined olive oil cannot be marketed on its own; it requires the addition of a small percentage (5–10%) of VOO—a process known as “coupage”—which provides color, aroma, and flavor to what would otherwise be a colorless, odorless, tasteless mixture of triglycerides. Currently, another type of olive-derived oil is also marketed: olive-pomace oil, obtained from the olive pomace (the residue left after olive pressing), which must likewise be refined and blended before it can be commercialized.

Extra virgin olive oil (EVOO) differs from VOO by having superior physicochemical properties (such as acidity, peroxide index, and lipid oxidation) and better organoleptic characteristics (free of defects and with a fruity profile). However, both are natural olive juices containing a variety of minor compounds that are absent from refined “olive oil” and “olive-pomace oil,” because these components are lost during refining. Currently, it is known that many of these minor components play an important role in the health benefits of these oils. Among them, the most notable are **biophenols**, also known as **polyphenols** (4). These molecules have antioxidant and anti-inflammatory properties and, as will be explained later, are highly beneficial for health—particularly for individuals with diabetes. In conclusion, “olive oil” and “olive-pomace oil” contain low levels of biophenols due to refining, whereas VOO and especially EVOO contain much higher levels, making them healthier options (*Figure 1*). Moreover, biophenols degrade easily and, as mentioned previously, EVOO has superior physicochemical stability compared with VOO, allowing it to preserve biophenols for a longer time. For these reasons, EVOO generally offers the best preservation of these important compounds, followed by VOO, and lastly “olive oil” and “olive-pomace oil.”

The biophenols naturally present in olives—found mainly in EVOO and VOO—provide antioxidant and anti-inflammatory effects. However, because they are natural products, the biophenol content of VOO/EVOO is variable; it depends largely on the olive variety, the type of soil in which the olive tree grows, and the climatic conditions of »

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“OLIVE OIL,” “OLIVE POMACE OIL,” VIRGIN OLIVE OIL (VOO), AND EXTRA VIRGIN OLIVE OIL (EVOO) ARE VERY DIFFERENT PRODUCTS, AND THEIR MINIMAL PRICE DIFFERENCE PER LITER DOES NOT REFLECT THE REAL DIFFERENCES IN THEIR COMPOSITION AND HEALTH PROPERTIES

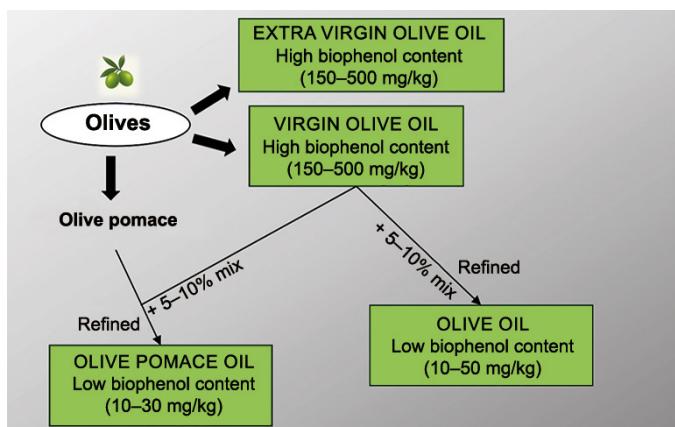


FIGURE 1. Olive oil production process. Created by the authors with assistance from AI (ChatGPT, OpenAI, 2025).

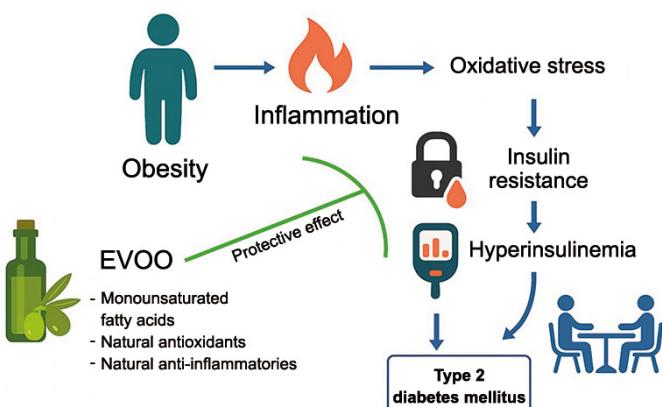


FIGURE 2. Relationship between obesity, inflammation, and the development of type 2 diabetes mellitus. Created by the authors with assistance from AI (ChatGPT, OpenAI, 2025).

» each harvest year. Therefore, to select a VOO or EVOO with a **high biophenol content** (above 300 mg/kg), it is necessary to know the phenolic composition of the available oils. This information is not required on product labels but is often accessible in olive mills (almazaras), where EVOO is extracted and sometimes sold. Currently, although the European Union recognizes the health benefits of VOO/EVOO polyphenols(5), including this information on labels is not mandatory, making it difficult to choose a product based on its polyphenol content—especially when purchased in shops or supermarkets. This lack of information also leads many consumers to perceive “olive oil,” “olive-pomace oil,” VOO, and EVOO as comparable products, when in fact they are very different and the small difference in price per liter does not reflect the true differences in composition and health properties.

BIOPHENOLS FROM EVOO/VOO AND DIABETES

Until recently, it was thought that triglycerides rich in oleic acid were primarily responsible for the health benefits of olive oil. However, both preclinical studies and clinical trials comparing refined ‘olive oil’ with extra virgin olive oil (EVOO) have demonstrated a greater ability of EVOO to counteract inflammatory and oxidative processes. These differences have been attributed specifically to its biophenol content (6). This is highly relevant for individuals with diabetes, a disease in which inflammation and oxidative stress play a fundamental role in both the onset and progression of the disease. In **type 2 diabetes associated with obesity**, excess fat accumulation triggers a state of systemic inflammation linked to insulin resistance (*Figure 2*). Despite the presence of insulin in the bloodstream, glucose is taken up less efficiently by tissues, leading to persistently elevated blood glucose levels (hyperglycemia). In response, the endocrine pancreas (the organ that produces and releases insulin) receives a continuous signal to produce more insulin. This increased demand induces oxidative stress and cellular damage in pancreatic endocrine cells, eventually causing their death and reducing the pancreas’ capacity to produce in-



» sulin. Over time, the persistent combination of inflammation, insulin resistance, hyperglycemia, and hyperinsulinemia becomes a vicious cycle that destroys insulin-producing cells. As a result, patients ultimately require exogenous insulin therapy and face a higher risk of microvascular and macrovascular complications caused by chronic hyperglycemia, including retinopathy, nephropathy, neuropathy, and cardiovascular, cerebrovascular, and peripheral vascular disease.

Research in cell lines and animal models of diabetes has shown that speci-

fic biophenols found in virgin and extra virgin olive oils can protect insulin-producing cells and reduce systemic inflammation. Molecules such as **tyrosol**, **hydroxytyrosol**, **oleacein**, and **oleocanthal**—present in virgin and extra virgin olive oils but scarce in refined 'olive oil'—have demonstrated beneficial effects in these settings (7). However, clinical trials in individuals with obesity, prediabetes, and type 2 diabetes mellitus have further confirmed that EVOO offers significant health benefits and is superior to refined 'olive oil.' (6, 8). Specifically, EVOO has been shown to lower

blood pressure, reduce LDL ("bad") cholesterol, increase HDL ("good") cholesterol, decrease LDL oxidation, improve insulin sensitivity, and support weight loss and long-term weight maintenance. These benefits have been observed with a daily intake of 25 mL of EVOO (approximately two tablespoons), with improvements evident after just three weeks—provided that the EVOO contains at least 300 mg/kg of phenolic compounds (6).

Of note, some polyphenols with strong antioxidant and anti-inflammatory pro-

» perties—such as oleocanthal and oleacein—are present only in certain olive varieties, including Picual, Cornicabra, and others.

Additional studies have shown that EVOO is beneficial for individuals with type 1 diabetes as well, reducing postprandial blood glucose levels and improving vascular function (9). Moreover, obesity and insulin resistance are increasingly common in people with type 1 diabetes, making glycemic control even more challenging in this population.

IMPORTANCE OF NUTRITION, PHYSICAL ACTIVITY, AND HEALTHY LIFESTYLE HABITS IN DIABETES

Diabetes, in all its forms, is characterized by the inability to maintain normal blood glucose levels. Persistent hyperglycemia leads to multiple complications that reduce both quality and expectancy of life. Maintaining adequate glycemic control is therefore essential, requiring close medical follow-up. Hypoglycemic drugs are increasingly effective and safe, but they are not sufficient on their own. Physical activity is crucial for maintaining adequate muscle mass and counteracting excess dietary calories, and is also important for mitigating muscle loss associated with certain antidiabetic therapies—such as GLP-1 receptor agonists—that are widely used today. Avoiding harmful habits such as tobacco and alcohol is equally important. Nutrition is fundamental and should emphasize a varied, balanced diet rich in fruits, vegetables, legumes, and fish, while avoiding ultra-processed foods. As the primary source of dietary fats, EVOO or VOO should be used whenever possible. **D**

CONCLUSIONS

- The Mediterranean diet protects against the development of diabetes and related cardiovascular diseases.
- Fats and other types of dietary lipids are necessary for proper physiological functioning.
- Not all olive-derived oils are equal in terms of health benefits.
- Olive biophenols—present mainly in EVOO and VOO—provide antioxidant and anti-inflammatory properties that support cellular survival and function.
- Biophenols in EVOO and VOO are especially beneficial for individuals with diabetes.
- Diabetes management requires a comprehensive approach that includes not only pharmacologic therapy but also regular physical activity and a Mediterranean dietary pattern with EVOO or VOO as the primary source of dietary fats.

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