# HEALTH BENEFITS OF AVOCADO OIL

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## Introduction

The Mediterranean diet is today considered to be a model for healthy eating. It is characterized by foods low in saturated fats and high in monounsaturated fats, balanced by polyunsaturated fats (omega-6 and omega-3), low in animal protein, rich in complex carbohydrates, and full of fiber. Today, scientific research has allowed us to propose that the secret behind the goodness of this diet are found in its antioxidant components, provided by fresh fruit, vegetables, wine and olive oil, and in fatty acids such as omega-3, found in fish and vegetables. These components help prevent chronic illnesses such as cardiovascular disease, cancer, Alzheimer's sickness, obesity, diabetes and various others (6).

The beneficial properties of olive oil are located in its chemical structure. This oil is rich in monounsaturated fatty acids, low in saturated and polyunsaturated fats, and high in antioxidants (6).

Extra virgin avocado oil, extracted by cold press or centrifuge from the pulp of ripe avocados, has a similar chemical composition to olive oil, although its levels of vitamin C, beta-sitosterol and chlorophyll are much higher, and it has much lower levels of **esqualene** and polyphenols (2).

Table 1 shows a typical analysis for extra virgin avocado and olive oil produced in Chile and New Zealand.

**Table 1**: a typical analysis of Chilean and New Zealand extra virgin avocado and olive oil.

| **Analysis** | **Chilean avocado oil[(a)]** | **New Zealand avocado oil[(b)]** | **Chilean olive oil[(c)]** | **New Zealand olive oil[(b)]** |
|---|---|---|---|---|
| AGL (%) | 0,14-0,40 | 0,08-0,17 | 0,12-0,30 | 0,15-0,25 |
| Peroxides index (meq/kg) | 2-5 | 0,1-0,2 | 3-6 | 1-2 |
| Specific weight (25 °C) | 0,910-0,920 | 0,915-0,916 | - | 0,914-0,918 |
| Iodine index | 84-90 | 82-84 | - | 75-82 |
| Phytosterol (%) | 0,43 | - | - | - |
| Beta-sitosterol (%) | 0,32 | 0,45-1,0 | - | 0,1-0,2 |
| Chlorophyll (ppm) | - | 40-60 | - | 4-6 |
| Vitamin E (ppm) | 292 | 130-200 | - | 100-150 |
| Alfa tocopherol (ppm) | 292 | 130 | - | 100 |
| Beta/Gama- tocopherol (ppm) | 0 | 15 | - | 10 |
| Copper (ppm) | - | <0,05 | - | 0,05-0,1 |
| Pesticides | - | ND | - | ND |

(a) Information supplied by the author.

(b) Eyres et al. (2003)
(c) Information supplied by the engineering agronomist Ángela Casté.

## Composition of fatty acids

Avocado oil is very similar to olive oil, which itself is an essential component of the Mediterranean diet, as it is rich in monounsaturated fatty acids and low in saturated fatty acids, and is free of cholesterol (1.3). Table 2 shows the fatty acid composition of extra virgin avocado and olive oils from Chile and New Zealand.

Both avocado and olive oil, thanks to their fatty acid content, help lower cholesterol-LDL (bad cholesterol) and increase cholesterol-HDL (good cholesterol). Oleic acid, which is the main monounsaturated fatty acid found in avocado and olive oil, increases the absorption of omega-3 polyunsaturated fatty acids in cell membranes and lowers the possibility that LDL oxidizes, both processes helping to reduce the risk of cardiovascular disease (3,6).

**Table 2**: Fatty acid composition of Chilean and New Zealand extra virgin avocado and olive oil.

| Fatty acids | Chilean avocado oil[(a)] | New Zeland avocado oil[(b)] | Chilean olive oil[(c)] | New Zealand olive oil[(b)] |
|---|---|---|---|---|
| C14:0 Myristic acid | 0,03-0,07 | - | - | - |
| C16:0 Palmitic Acid | 9,0-18,0 | 12,5-14,0 | 10,0-14,0 | 8,6-12,9 |
| C16:1 Palmitoleic Acid | 3,0-9,0 | 4,0-5,0 | 0,4-1,3 | 0,3-0,7 |
| C17:0 Heptadecanic Acid | - | - | 0,02-0,1 | - |
| C17:1 Heptadecanoic Acid | - | - | 0,07-0,16 | - |
| C18:0 Estearic Acid | 0,4-1,0 | 0,2-0,4 | 1,4-2,0 | 2,1-2,8 |
| C18:1 Oleic Acid | 56,0-74,0 | 70,0-74,0 | 75,0-81,0 | 77,0-82,6 |
| C18:2 Linoleic Acid | 8,0-19,0 | 9,0-10,0 | 4,5-9,0 | 4,6-7,5 |
| C18:3 Alpha Linolenic Acid | 0,0-2,0 | 0,3-0,6 | 0,6-0,8 | 0,5-0,7 |
| C20:0 Araquidic Acid | 0,0-1,05 | 0,1 | 0,2-0,4 | 0,0-0,6 |
| C20:1 Gadoleic Acid | - | 0,1 | 0,2-0,35 | 0,0-1,4 |

(a) Information supplied by the author.
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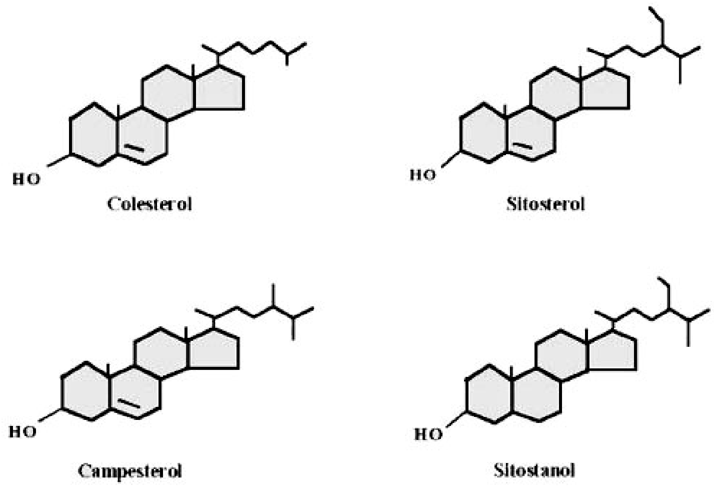
## Phytosterols and Phytostanols

Phytosterols and phytostanols (the saturated form of phytosterols) are esterols of plant origin whose chemical structure is very similar to cholesterol. Phytosterols differ structurally from cholesterol by a methyl or ethyl group in the hydrocarbonate side chain of the molecule. In phytosterols the hydrocarbonate chain is formed by 9 or 10 carbon atoms, some of which present a double bond (stigmasterol), while in cholesterol this chain is formed by 8 carbon atoms and is saturated (Figure1) (1,4,7).

Figure 1: Chemical structure of cholesterol and the main phytosterols and phytostanols.



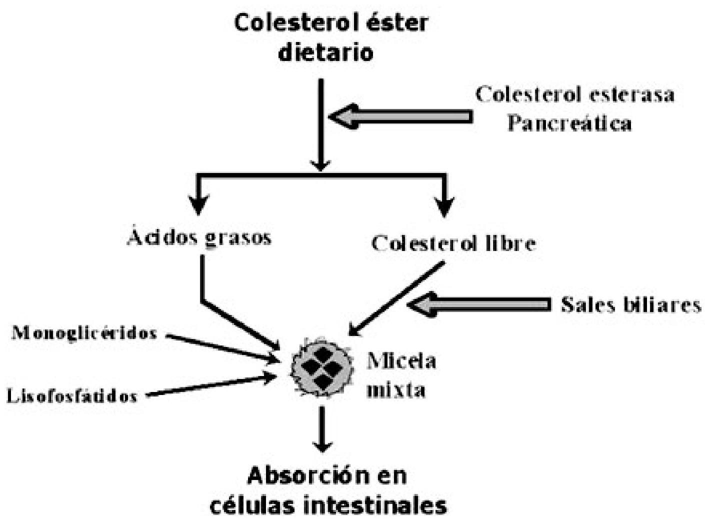

Phytosterols and phytostanols are abundant in the plant kingdom, as they are present in fruits, seeds, leaves and stems of practically all known vegetables. The most common phytosterols are: beta-sitosterol, campesterol and stigmasterol, which together form 95 to 98% of all identified phytosterols (1,4,7).

In extra virgin avocado oil are found the phytosterols and phytostanols beta-sitosterol, avenasterol, campesterol, stigmasterol and stigmastenol, the most common being beta-sitosterol. Typical levels of beta-sitosterol found in virgin avocado oils are 0.45% to 1.0%, while in extra virgin olive oils the levels of beta-sitosterol are 0.1% to 0.2% (Table 1).

The high levels of plasmatic cholesterol represent an important risk factor for cardiovascular disease, which is the main cause of death in the industrialized world (4,7).

Daily cholesterol intake can vary from 250 mg up to 500 mg (or more in some cases). Between 95% to 98% of the cholesterol we ingest is sterified with fatty acids from the carbon 3 OH group from the cyclic compound of the molecule. Generally, the constituents of this carbon compound are palmitic acid (CI6:0), estearic acid (C18:0), oleic acid (C18:1) and to a lesser degree linoleic acid (C18:2). Cholesterol esters do not suffer any changes during oral and gastric digestion, as these cavities do not secrete cholesterol esterase, although they do secrete lipases. The pancreas secretes towards the small intestine a powerful cholesterol esterase that hydrolyzes almost 100% of the cholesterol esters with the help of bile salts, the components of which act as enzyme activators. The free cholesterol found in the intestinal lumen during the digestive process is made up of dietary cholesterol (600-1000mg per day) and by the cholesterol contained in bile secretion (600-1000 mg per day). Free cholesterol is incorporated into the mixed micelles and are “trapped’ or “solubilized” in the phospholipidic segment that forms on the surface of these micellic structures. These micelles, which also contain free fatty acids, monoglyceroids, lysophospholipids and phosphoglycerate, draw closer to the brush border of the microvillus of the intestinal epithelial where turbulence of intestinal content is very low and on contact with the membrane they transfer their contents into the inside of the cell. It is estimated that almost 50% of cholesterol is re-absorbed and the rest is eliminated through body waste. It is necessary to underline that cholesterol, as opposed to other molecules, is not metabolized, thus the only form of elimination is intestinal (4,7) (Figure 2).

Figure 2: Metabolism of cholesterol



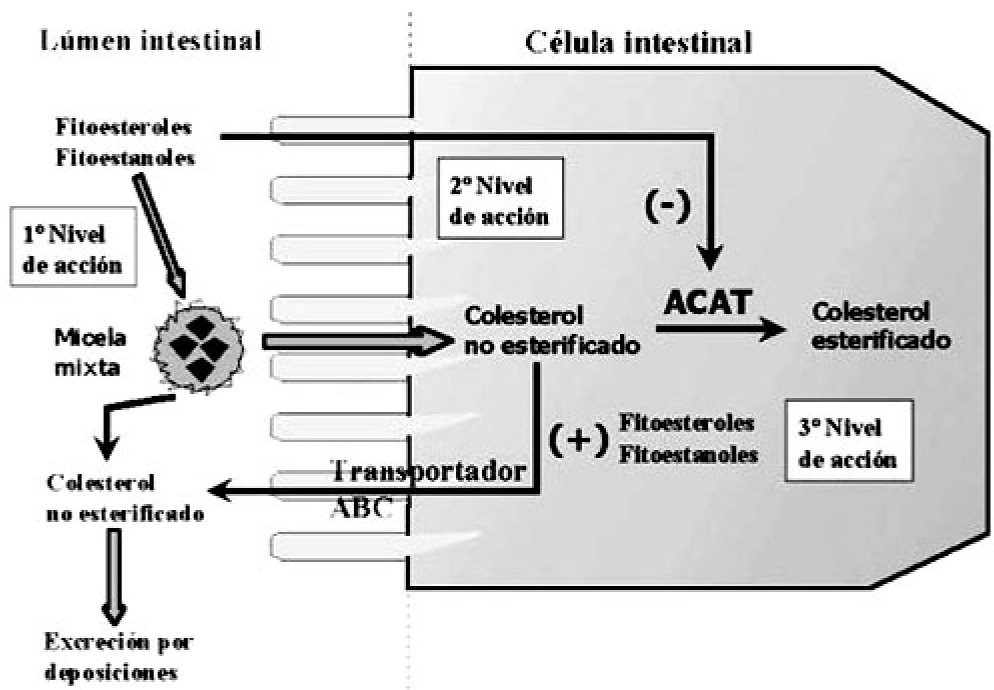

Today, scientific evidence attributes a large variety of physiological health benefits to phytosterols and phytostanols. They have been found to have anti-inflammatory, anticancer, bactericide and fungicidal properties. However, the health benefit that has most interested science is the hypocholesteroemic effect on persons with moderate hypercholesterolemia (above 200 mg/dL up to 240 mg/dL), both at the level of total cholesterol as well as LDL-cholesterol (4,7).

The hypocholesteroemic effect of phytosterols and phytostanols is attributed to three active mechanisms (7) (Figure 3):

1.- They inhibit the absorption of cholesterol at intestinal level, as regards both dietary cholesterol as well as cholesterol produced by bile salts. Due to the fact that phytosterols and phytostanols are more lipophilic than cholesterol, they competitively displace the cholesterol from the mixed micelles formed by the action of the phospholipids and the bile salts in the intestinal lumen. Thus, when the mixed micelles make contact with the microvillus of the intestinal cells, the phytosterols and phytostanols occupy the place of cholesterol. The non-emulsified cholesterol, displaced by the mixed micelles, cannot be absorbed and is eliminated in body waste. Furthermore, the phytosterols and particularly the phytostanols show a low absorption rate at intestinal level, which is why during the transfer process of fatty acids and monoglyceroids from the micelle to the intestinal cells, producing the disassembly of the mixed micelles, the phytosterols and phytostanols are

liberated so accompanying the non-absorbed cholesterol, finally being excreted as body waste.
2.- They inhibit the reesterification of cholesterol at the activity level of the acyl-coenzyme A: cholesterol acyltransferase (ACAT) enzyme. Intestinal absorption of phytosterols is extremely low (less than 0,5%-1%) and that of phytostanols lower still. Nevertheless, when phytosterols and phytostanols are absorbed, they inhibit ACAT, which is why cholesterol will not be efficiently reesterified and incorporated into chylomicrons, so stimulating the flow of non-esterified cholesterol towards the intestinal lumen.
3.- They increase the activity and expression of ABC-type transporters, accelerating the flow of cholesterol from intestinal cells to the intestinal lumen. The phytosterols will produce an over-expression of the genes that codify the proteins in the ABC transporter structure, so accelerating the flow of non-esterified cholesterol towards the intestinal lumen.

Figure 3: Action mechanisms of phytosterols and phytostanols in cholesterol metabolism.



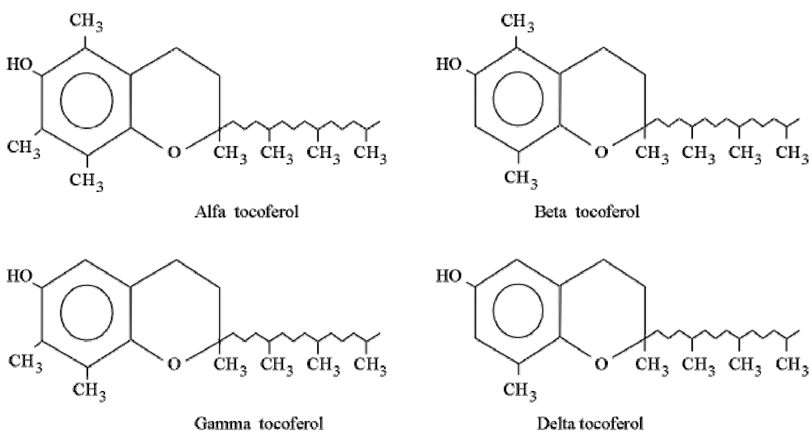

The hypocholesteroemic effect of phytosterols and phytostanols takes place when their daily ingestion is in the range of 1-3g per day. The seric concentrations of phytosterols is in the range of 0,3-1,7 mg/dL, and that of phytostanols less than 0,1 mg/dL, which are a lot less than that of cholesterol (150-300 mg/dL) (4,7).

## Vitamin E

Vitamin E is made up by a group of 8 components. Its structure consists of 2 primary parts: a complex ring and a long side chain. These 8 components are divided into two main groups: tocopherol and tocotrienol, which are differentiated in the saturation of the side chain. The tocopherols possess a saturated side chain whereas that of tocotrienol is unsaturated with 3 double bonds (2, 5).

Depending on the number and position of the methyl group in the ring, the tocopherols are classified in Alpha, Beta, Gamma and Delta tocopherols (Figure 3).

Figure 3: Chemical structure of Alpha, Beta, Gamma and Delta tocopherols.




Vitamin E belongs to the liposoluble group of vitamins and is found in a large variety of foods, being one of the most widely distributed vitamins. The main sources of vitamin E are oils, legumes, cereals, butter and eggs (5).

Extra virgin avocado oil can have a vitamin E content higher than 200 ppm, sometimes reaching levels of 300 ppm, which are higher concentrations that those found in extra virgin olive oil (2). The main component found in extra virgin avocado oil is alpha-tocopherol (Table 1).

The recommended nutritional intake of vitamin E is between 3 to 4mg for breast-feeding babies, 8mg for women and 10mg for men (5). In a 15ml (14g) portion of avocado oil, there can be between 2.8 and 4.0mg of vitamin E, equivalent to 28% and 40% of a person's daily requirements, respectively.

The benefits of vitamin E are: a) protection of cells against the damage of free radicals, b) diminishing the risk factors linked to certain cancers, c) protecting the oxidization of LDL-cholesterol, d) improving the immune response, and e) protection against the formation of cataracts. The main function is as a natural antioxidant that reacts with soluble free radicals in the lipids of cell membrane, protecting the lipoproteins and unsaturated fatty acids. Vitamin E reduce the speed of the attack by free radicals on polyunsaturated fatty acids present in the phospholipids of the cell membrane (5).

## Chlorophyll

Chlorophyll is pigmentation present in plants and green seaweed, and is responsible for the absorption of light energy during the process of photosynthesis.

Extra virgin avocado oil contains high levels of chlorophyll (40-60 ppm), which is why the oil has an emerald-green color; the chlorophyll content of extra virgin olive oil, on the other hand, is ten times smaller (4-6 ppm) (1,2).

Although chlorophyll can have a negative effect on the oxidative stability of the oil, as it can produce the photooxidation of the oil if it is exposed to light, consumers consider its color as a beneficial attribute (1,2). To increase the oxidative stability of extra virgin avocado oil for the whole of its useful shelf life, exposure to light should be avoided, using dark bottles, as well as exposure to oxygen in the air, via the use of nitrogen in the storage tanks and during the bottling stage of production.

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