Chapter

This is the Nut You Should be Eating for Better Gut Health

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Abstract

The consumption of dried fruit is a dietary habit that is growing year by year. Nutrition specialists and others have carried out numerous studies confirming that the introduction of a controlled daily intake in the diet can bring benefits both in the prevention of major metabolic and cardiovascular diseases and in the well-being of the microbiome. The intake of dried fruit plays an important role in improving the quality and quantity of the microbial families of our intestine, leading to an increased production of short-chain fatty acids, which participate in numerous pathophysiological mechanisms and in the prevention of numerous diseases. The present review chapter compares numerous articles focusing on the characteristics and behavior of fibers and other main components of nuts.

Keywords: dried fruit, nut, Mediterranean diet, microbiome

1. Introduction

Oily dried fruit is a different food from dried fruit (figs, apricots, plums, and raisins) because the latter has a high sugar content and is therefore particularly suitable for the beginning of the day because it provides a load of immediately available energy. Dried fruit, such as nuts and various seeds, is the vehicle for the reproduction of vegetables; within them is the potential of the entire plant. The term "walnut" commonly indicates the seed of a tree enclosed in a woody casing, but many seeds that we consider "nuts," such as peanuts, do not correspond to the strict definition of pure walnut.

There are more than 300 types of walnut, and all of their plants produce seeds, but only a few are very important as a product for food and human health

In terms of world production, coconut is the most widely grown and used, followed by peanuts; both account for about 94% of world walnut production. The main reason is that both coconut and peanuts provide oils that are among the essential ingredients of cooking oils, margarine, and cooking fats at a low price. For example, peanuts are the most known nut in the United States, and the harvest exceeds 70% of the annual nut production, followed by almonds, walnuts, and pecans.

Unfortunately, nuts are usually eaten after being fried in fat and salted or as an ingredient in sweets and packaged and ultra-processed foods. Today, many people are trying to orient themselves to healthier foods, and the consumption of nuts and oil seeds is growing dramatically!

It is worth mentioning that oily fruit contains essential nutrients and substances defined as "anti-nutrients" but always to a lesser extent than healthy ones, which are fibrous compounds, protease inhibitors, ellagic acid, and other polyphenols. Since nuts and seeds contain a large amount of oil, one might think that eating nuts frequently would increase the rate of obesity. Still, worldwide epidemiology shows us, on the contrary, that obesity is less common among nut eaters, and one of the positives is thought to come from a greater sense of satiety and appetite satisfaction. In general, nuts and oil seeds, due to their high oil content, should be purchased and stored still in the shell because it is a natural protector against free radical damage caused by light and air. It is discouraged to eat moldy nuts and seeds and use them for cooking because they pose a health risk, just as the use of chewy, dark, or wilted nuts is similarly not recommended. Instead, it is advisable to store nuts and oilseeds in their shells in a cold, dry environment, and if by chance you are forced to buy them unshelled, be sure to seal them in airtight containers in the refrigerator or freezer. Chopped or sliced walnuts, in general, are rancid, and it is preferable to prepare them at home, using whole walnuts.

The nutritional characteristics of the two types of fruit are a high sugar content for dried fruit and a high quantity of calories for dried fruit. The high-calorie intake is due to its high fat content, especially polyunsaturated fatty acids, such as alpha-linolenic acid (ALA). Another type of fat found in this food is eicosapentaenoic acid (EPA). These two types of fats are an excellent source for people who do not eat fish.

Oily dried fruit is a large family, including hazelnut, with high fat content. It is a food that is present in diets because its characteristic aroma makes it versatile in the combination of other flavors, and it is a widely used ingredient in commercial confectionery products. During the second world war, cocoa was challenging to find, and hazelnut was used to prepare products that resembled chocolate. After the war, when the cocoa supply returned to normal, confectionery producers found that the public's taste remained oriented toward specialties in which the hazelnut aroma sweetened the cocoa aroma's sourness. Consumers' preferences are generally oriented toward large, somewhat round, well-colored, and hard-shelled hazelnuts. Hazelnuts contain omega-3 and omega-6 unsaturated fatty acids and are rich in fibers that facilitate intestinal transit and, in turn, make you absorb less sugar and less fat.

Walnuts contain the kernel, the part eaten with a pleasant flavor and with a delicate taste. Walnut is very nutritious and has a high calorific value, as it includes a characteristic oil in a percentage that varies, depending on the variety, from 55% to 65%. The high-calorie nature of walnuts makes them undesirable for those who want to lose weight, as they provide many calories.

Walnut oil contains alpha-linolenic acid (ALA), a precursor of omega-3 fatty acid, called EPA. The intake of four walnuts per day leads to the presence of EPA in the body, similar to that obtained from eating fish. The nut is appreciated as a dessert and is sought after as a delicacy at the end of a meal, as it stimulates the taste of drinking.

From a nutritional point of view, almonds are similar to walnuts. They, too, contain an oil with a high percentage of omega-3 and omega-6 and a minimum amount of water; almond is, therefore, a high-calorie food. It is an essential source of mineral salts such as phosphorus, calcium, iron, copper, and magnesium. Almonds are often eaten dry and can be distinguished as dry and bitter. They can hardly be digestible due to their high oil content.

Almond oil is extracted by applying pressure to a sweet variant. When it is emulsified with water and sugar, a natural laxative is obtained that can also be given to

children. If you add a small dose of bitter almond oil to this preparation and dilute it, it becomes the basis for preparing barley.

For many years, numerous scientific studies have confirmed that a balanced diet, such as the Mediterranean diet, allows you to prevent numerous chronic diseases and that, in pathological conditions, diet is an integral part of medical therapy. Diet plays a crucial role in the etiology of numerous chronic diseases, thus contributing to significant geographic variations in chronic disease morbidity and mortality rates in different countries and populations worldwide [1].

The daily eating style, in addition to having an essential role in prevention, can be one of the causes of some metabolic diseases if you follow an unbalanced diet. It has also been found that it significantly influences the composition of the intestinal microbiota [2], where we can distinguish about 1014 commensal bacteria [3] grouped into seven different divisions: the most numerous are those of the Bacterioidetes families (in particular, Bacteroides and Prevotella) and Firmicutes, which are more than 90% of the total population [4], and in the remaining 10%, we find archaea, viruses, parasites, and fungi [5].

The microbiological families make up the microbiota and feed on the fermentation of non-digestible food carbohydrates [6], producing gas, some organic acids, and short-chain fatty acids (SCFA) [4, 6, 7]. The latter are acetate, propionate, and butyrate and have a crucial role in human health [7]. Butyrate acts on the intestinal mucosa by activating the synthesis of mucin and favoring the formation of tight junctions [8], essential for maintaining intestinal permeability.

SCFA, as confirmed by the scientific literature, plays a role in the modulation of the immune system [9, 10] by regulating the production of pro-inflammatory cytokines and chemokines [9, 11] and the function of T lymphocytes [10].

2. What is a dried fruit?

When we talk about taking dried fruit in the daily diet, we refer to nuts, including oily achenes.

Walnut is one of the many names used to refer to the oily achenes produced by different plant species. These include walnuts, hazelnuts, almonds, pistachios, pine nuts, peanuts, Brazil nuts, pecans, cashews, and macadamias. Generally rich in protein and exceptionally energizing, the above-mentioned oily nuts represent an essential natural nutritional choice in vegetarian and sports nutrition. Thanks to their richness in fiber and excellent content of mono- and polyunsaturated fatty acids (especially walnuts), they exert a protective action against the so-called wellness diseases, such as diabetes, hypercholesterolemia, and obesity.

For these assumptions to be valid, dried fruit must be consumed sparingly, replacing (never adding to) other less-healthy lipid sources (such as animal fats). Given its high caloric value and great fat richness, dried fruit should be eaten away from main meals, contextualized in snacks, perhaps in combination with fresh fruit (e.g., an apple and some almonds or a kiwi or some walnuts).

A reasonable serving shouldn't exceed 30 g, however. If associated with fresh fruit, it represents an excellent snack and a good ally for our health and daily well-being. The dried fruit marketed with its shell does not guarantee the quality of the product, but it is healthier than a chopped or shelled one. The latter category of food, even if packaged in sealed containers, requires the addition of artificial antioxidants, necessary to avoid the rancidity of fats and extend storage time.

The scientific communities have conducted and are conducting scientific studies for a healthy diet, where the daily intake of dried fruit is recommended. In one of the most significant studies on the Mediterranean diet PREDIMED enrolled in 2003 and 2011, over 7000 people were at high risk of cardiovascular events. The trial divided the participants into three groups: a Mediterranean diet supplemented with extra virgin olive oil, a Mediterranean diet enriched with dried fruit (walnuts, hazelnuts, and almonds), and a low-fat isocaloric diet (animal and vegetable). The two groups assigned the Mediterranean diet adhered well to the dietary regimen and improved clinical analyses. The study showed that for patients with high CVD risk, the Mediterranean diet with extra virgin olive oil or dried fruit intake reduces the incidence of cardiovascular disease [12].

For some time now, clinical studies have focused on the beneficial properties of dried fruit as cardiovascular prevention, especially for coronary heart disease, and then extended to other pathologies [13].

Among the epidemiological studies carried out over the years, it has been found that a regular intake of dried fruit reduces the risk of death from CVD and a reduction in the risk of developing cardiovascular disease [14].

The benefit of dried fruit is the cholesterol-lowering effect, which explains its role in cardiovascular prevention. One of the most prominent large-scale cohort studies of 2005 showed a significant inverse association between the frequency of nut consumption and inflammatory markers (c-reactive protein, IL-6, and fibrinogen) [15].

Nutrition experts in dietary prescriptions recommend replacing ultra-processed foods that exceed in fat, sugar, and salt with nuts as snacks. This substitution helps lower the diet's glycemic load and therefore reduces the risk of developing cardiovascular disease. Among the various benefits of consuming nuts is the satiating power. The consumed fibers fill and quench hunger, making the next meal less excessive.

Having a low glycemic index, walnut, and other types of nuts, combined with a good amount of fat, reduce the total glycemic load of the meal.

The particles produced contain intact plant cells that derive from their fibrous and indigestible wall during chewing. The plant cell wall reduces the entry of digestive enzymes, slowing digestion and absorption of about 25% of the fats. The abrasive consistency of oily fruits allows these foods to be natural exfoliants, removing plaque and stains from tooth enamel. Once in the stomach, they manage to activate the satiating power. In the intestine, soluble fibers such as inulin help reduce the gases produced physiologically by the intestinal microbiota.

3. The nutritional differences of dried fruit

Nuts are also called lipid fruit, as they are low in water and high in fat. The most common are:

- **Walnuts**: They contain little water (3–4%); a good share of oil (60%); and a share of proteins (20%), vitamin E, calcium, iron, and zinc.

- **Almonds**: They contain many lipids (up to 60%), polyunsaturated fatty acids, proteins (20%), potassium, calcium, iron, and zinc. The amygdalin (laetrile) in them has anticancer activity. There is an excellent relationship between arginine and lysine; therefore, they not recommended for those suffering from herpetic infections.

- **Pine nuts:** They are nutritionally very close to almonds, but they go rancid more easily and therefore require storage in the fridge in hermetically sealed containers.

- **Pistachios:** They are nutritionally similar to almonds, with a higher content of iron and thiamine and a lower content of calcium and niacin. They contain lipids (55%), proteins (20%), and B vitamins.

- **Hazelnuts**: Compared with almonds, they contain more lipids and are less protein rich. They are more caloric; 100 g corresponds to about 634 kcal.

- **Chestnuts:** They contain many more carbohydrates, a good amount of protein, and little fat. They are an excellent source of potassium, magnesium, iron, and manganese.

- **Cashews**: They contain a few lipids, of which 65% is composed of unsaturated fats, such as monounsaturated oleic acid (90%) and linoleic acid (10%). They contain magnesium, potassium, and zinc. The shell of cashews contains caustic oil, which, if in contact with the skin, is harmful.

- **Peanuts**: They contain lipids (50%), proteins (20%), and carbohydrates (19%). They also contain B vitamins, potassium, magnesium, calcium, zinc, and iron. 75% of the fats present is unsaturated.

- **Brazil nuts**: They are similar to almonds, with more lipids. They also contain methionine and cysteine, which are helpful for those who follow a vegan diet.

- **Macadamia nuts:** They contain a lot of fat (72%) and little protein (8%).

- **Pecan nuts**: They have high fat content (71%), low protein, mineral salts, and B vitamins.

The queen of dried fruit is the walnut. The walnut is a very ancient plant; 9000 years ago, people started talking about this fruit. The name derives from the Latin "nux nucis," which included the walnut and similar fruits, those with a fleshy kernel, wooden shell, and fibrous rind.

The *Jungals regia* fruit tree (or white walnut) produces a fruit, the drupe, which is fleshy and composed of the husk (the fibrous outer part), and the shell (endocarp) that is the woody inner part. Inside the shell is the seed (kernel), which is edible. This plant, to date, is cultivated in many parts of the world with different cultivars:

- United States: We find Hartley and Howard nuts.

- California: We find Eureka, Payne, and Chandler.

- France: We find Franquette, Parisienne, Soleze (or Argor), Mayette, Walnut of Grenoble (has the AOP certification), Lara, and Meylannaise.

- Italy: Sorrento walnut, common walnut, Maliza, Corncola, Late or San Giovanni walnut, Bleggiana walnut, and Feltrina walnut.

Chandler is the most cultivated and resistant to infections and diseases among all these cultivars.

The nutritional characteristics per 100 g of walnuts are as follows:

- Energy: 689 kcal
- Carbohydrates: 5.1 g
- Starch: 1.8 g
- Soluble sugars: 3.1 g
- Protein: 14.3 g
- Lipids: 68.1 g
- Water: 3.5 g
- Total fiber: 6.2 g
- Soluble fiber: 0.84 g
- Insoluble fiber: 5.37 g
- Cholesterol: 0
- Calcium: 83 mg
- Potassium: 368 mg
- Sodium: 2 mg
- Phosphorus: 380 mg
- Iron: 2.1 mg
- Magnesium
- Zinc: 2.7 mg
- Copper: 1.5 mg
- Selenium: 3.1 μg
- Thiamine: 0.45 mh
- Riboflavin: 0.1 mg
- Niacin: 1.9 mg

- Vitamin C: traces
- Vitamin A: 8 μg
- Vitamin E: 3 mg

4. Benefits of dried fruit

Nuts are a valuable ally of our heart; their composition, especially of unsaturated fatty acids, helps reduce inflammation, improves blood pressure control, and regulates blood cholesterol levels: phytosterols, fiber, and mono- and polyunsaturated fatty acids help to contain LDL (the cholesterol dangerous for the heart) and to maintain reasonable levels of HDL (the "good" one), reducing the process of atherosclerosis and thus limiting the risk of blockage of the arteries.

In literature, there are many scientific studies with walnut as the protagonist. It is present in many dietary regimes, mainly the Mediterranean diet.

Among its nutritional characteristics, walnut is rich in good fats, especially omega-3 fatty acids, such as alpha-linolenic acid (ALA). The latter is the primary omega-3; it is an "essential" polyunsaturated fatty acid because our body cannot produce it on its own, hence the importance of consuming it with the diet. ALA keeps blood cholesterol levels low.

Walnut is also a source of essential minerals such as iron, magnesium, phosphorus, potassium, zinc, copper, and vitamin E—a powerful antioxidant. It does not contain cholesterol but a minimum amount of saturated fats and an overall percentage of mono- and polyunsaturated fats. This feature allows it to provide energy and carry vitamins (folate, niacin, and vitamin E) and minerals (magnesium and potassium), which are helpful not only for bone health, muscles, heart, and circulation, but also for the brightness of the skin and the strength of the hair.

Mono- and polyunsaturated fats are the components of cell membranes and some hormones, and they help keep the immune system active and the blood thin. They also contain bioactive compounds and protective substances such as tocopherols, phytosterols, and phenolic compounds and proteins and carbohydrates in balanced quantities and lots of fiber.

Given its composition, the walnut turns out to be a high-calorie food, so its consumption must be carefully dosed. An average walnut weighs about 8 g with a caloric intake of 35 kcal. Nutrition specialists recommend an intake of 15 g of walnuts per day for a caloric consumption of approximately 100 kcal.

Walnuts are very versatile in diets; they can be eaten as a snack or as a dessert, but they can also be associated with other foods, making them more palatable.

Given its nutritional characteristics, walnut is not considered only as a fruit or food. The European Commission, in regulation 43/2012, defined walnut as a natural nutraceutical food [16] as it improves the elasticity of blood vessels if consumed with a dose of 30 g per day. The nutraceutical power is given by the number of plant sterols, notably polyphenols, whose biological activity is potent. There are also large quantities of ellagitannins and ellagic acid, with antiviral, antibacterial, and antitumor properties [17].

Comparison with observational studies on European and American populations has shown that the Mediterranean diet, where walnuts are very present, leads to a reduced risk of mortality from numerous diseases over a 10-year follow-up [18].

A report on the PREDIMED study revealed that a group of about 1200 patients who followed the Mediterranean diet with walnut supplementation for 1 year gave a 14% reduction in the prevalence of metabolic syndrome, compared to a 2% reduction in the group assigned low-fat diet [19].

Another cross-sectional study compared four different diet regimens in a multi-ethnic group in North America. The group following a diet with cereals, fruit, and nuts showed a reduced risk of cardiovascular disease and a positive effect on inflammatory markers (inflammatory biomarkers, endothelial function, and homocysteine) [20].

From the scientific evidence, it can be asserted that the consumption of walnuts has a lipid-lowering effect; they reduce the risk of developing diabetes, especially in the female population and are not associated with weight gain and therefore not associated with obesity [21].

A recent meta-analysis evaluated the effect of walnut consumption on all causes of mortality from cardiovascular disease to cancer. The cohort studies were analyzed to support the decrease in mortality in individuals who eat walnuts [22].

Walnuts contain various dietary nutrients such as fiber, vitamins (folic acid, niacin, tocopherols, and vitamin B6), minerals (calcium, magnesium, and potassium), phytosterols, and phenolic compounds [23].

The fats present in walnuts are low in SFA and high in MUFA (oleic acid), with an abundant amount of PUFA (a-linolenic acid, omega 3) [24]. We also find a high content of L-arginine, a precursor of nitric oxide, with vasodilating power [25].

The cholesterol-lowering power is given by the phytosterols present in walnuts [26].

A recent study on the Chinese-Asian population targeting the prevention of type II diabetes mellitus and glycemic changes has considered the postprandial glycemic response (0–120 min) after the administration of high-protein nut bars compared to the administration of high-carbohydrate cereal bars. About 16–28 g of mixed nuts were also given daily. The objective was to evaluate the postprandial response of overweight adults with an increased risk of developing type 2 diabetes. The study showed that the intake of walnut bars suppressed the glycemic response and improved the postprandial hyperglycemic response. The high-risk group observed a 30% reduction in the overall glycemic impact [27].

Previous studies have confirmed the association between walnut intake and decreased cardiovascular risk and the development of type 2 diabetes mellitus [28, 29].

Some previous studies have shown that the intake of nuts suppresses postprandial blood sugar caused by the intake of foods rich in carbohydrates [30, 31].

5. Microbiome and dried fruit

Numerous families of bacteria populate the microbiome present in our intestines [32]. Numerous factors influence microbiota, such as age, diet, drugs, and the environment. These impact bacterial families in metabolizing nutrients derived from our diet and some drugs. The microbiota is a form of barrier for our intestines, it protects us from infections and, at the same time, it produces molecules (proteins, fatty acids, etc.) that participate in numerous physiologicals processes.

When the microbiome is altered, characteristic intestinal disorders such as irritable bowel syndrome (IBS) [33], constipation [34], and abdominal bloating can be correlated [35].

The intake of walnuts is healthy not only to reduce cardiovascular risks but also to promote the balance of intestinal bacteria in our microbiota.

Walnuts can be considered prebiotics and probiotics due to their bacterial content. Their peel contains many fibers. Their fermentation promotes the production of SCFA (such as butyrate, which optimizes intestinal contractility and mucus secretion) [36] and polyphenols with the antioxidant and anti-inflammatory properties.

It can be said that the consumption of dried fruit particularly promotes the growth of the Rosuberia bacterial family, which protects the intestinal lining. The bacterial family Eubacteria Eligens also grows after the intake of walnuts and is associated with an improvement in blood pressure.

The bacterial family of Lachnospiraceae has been associated with more significant reductions in blood pressure, total cholesterol, and non-HDL cholesterol.

In 2020, a systematic review and meta-analysis of controlled studies on the effect of nut intake on the microbiota was published. The study also evaluated bowel function and its symptoms in healthy adults [37].

Studies with findings related to fecal microbiota were included in the review; all studies measured how phyla behaved after walnut intake, in particular Actinobacteria, Bacteroidetes, Firmicutes, Proteobacteria, and Verrucomicrobia [38, 39].

From this comparative study, it can be confirmed that the consumption of walnuts affects the composition of the microbiota. Still, given the results, there is a confirmation at the level of gender and not directly on the species or the diversity, depending on the duration of intake of the walnuts. Although the number of comparative studies is few, the study on the effects of nut consumption on the microbiota needs further trials [40].

In another comparative study [41], the microbiota was evaluated in a pediatric and adult population. All enrolled children had reached the age of three, as a 3-year-old child's microbiota is comparable to an adult's [42]. This population was given whole or partially processed walnuts and compared with populations that either did not eat walnuts or ate them in negligible doses.

The studies measured the microbiota with innovative techniques, with complete analyses allowing for quantification and taxonomic identification.

The Holscher study was compared where the population was given 42 g of walnuts daily for three weeks. No significant differences were found in the size of the entire sample, but the intake of walnuts significantly influenced the bacterial families. A decrease in Actinobacteria and a substantial increase in Firmicutes were observed. An increase in the genera Faecalibacterium, Clostridium, Roseburia (cluster of Clostridium XIVa and IV), and Dialister (49–160% more relative abundance) and a reduction in the genera Ruminococcus, Dorea, Oscillospira, and bifidobacteria (16–38% relative abundance inferior) were also observed [39].

From the data that emerged, it can be deduced that a diet with numerous different foods can temporarily reduce microbial diversity. This consequence is called the "shock effect." These results contradict those in the scientific literature, suggesting that adherence to a varied dietary model increases intestinal microbial diversity [43]. In numerous dietary models and, in particular, in the Mediterranean diet, microbial changes are already measured after three to four days of adherence to the diet [44].

From this study, it was concluded that among the various types of dried fruit, nuts are the ones that have the most significant effect on the microbiome due to their abundance of polyphenols and omega 3, considered prebiotics. The limitation of these studies is the numerical scarcity and the data collected in the microbiome after short-term intake of walnuts [41].

6. Conclusions

In this chapter, we wanted to highlight how the intake of dried fruit and, in particular, walnuts could be beneficial for our bodies.

We have evaluated numerous studies and articles, and we can summarize and highlight the following issues:

- Taking nuts with a controlled and daily dose as part of a balanced diet such as the Mediterranean diet helps prevent major metabolic and cardiovascular diseases
- The fibers in walnuts and dried fruit help fight excess gastric acidity and intestinal absorption of many nutrients and participate in the balance and growth of the intestinal microbial population. Dried fruit can be defined as "prebiotic," thanks to its fiber content.
- The microbiota metabolizes fibers and polyphenols derived from dried fruit, and thanks to these, it can improve the production of SCFA that participate in numerous physiological processes. Many bacterial families grow up expressing their beneficial effects of preventing and protecting countless metabolic diseases.
- Given the recommended daily rate, dried fruit can be a snack; as a high-calorie food, it can help combat asthenia, improve concentration during studies, be a deal-breaker for those on a low-calorie diet, and be an excellent snack for athletes to prepare for training or competition.
- The fats in dried fruit are omega 3 fats that protect our vessels and the heart. They are an excellent alternative for those who follow a vegan diet. In addition to fats, they are an excellent source of folic acid and mineral salts.
- The Mediterranean diet has always promoted and recommended the intake of dried fruit and fiber. It appears that dried fruit consumption is increasingly widespread and that the scientific community, hopefully, continues to study its beneficial effects.

Acknowledgements

The present work has been developed in collaboration with the VIRTUOUS project, funded by the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie-RISE Grant Agreement No 872181 (https://www.virtuoush2020.com/).

Conflict of interest

The authors declare that the research was conducted without any commercial or financial relationships construed as a potential conflict of interest.

DOI: http://dx.doi.org/10.5772/intechopen.108567

Acronyms and abbreviations

SCFA	short-chain fatty acids
SFA	short fatty acids
IBS	irritable bowel syndrome
MUFA	monosaturated fatty acids
PUFA	polyunsaturated fatty acids
ALA	alpha linolenic acid
CVD	cardiovascular disease
EVO	extra virgin olive oil
EPA	eicosapentaenoic acid
LDL	low-density lipoprotein
HDL	high-density lipoprotein

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