EXTRA VIRGIN OLIVE OIL: PROCESSING, QUALITY, SAFETY, AUTHENTICITY, NUTRITIONAL, HEALTH AND ORAL HEALTH ASPECTS

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“Olea europaea”

The cultivation of olive trees, harvest of olives, and subsequent liquid extraction to produce olive oil have been inherently linked to the history and culture of Mediterranean populations. The pivotal role of olive oil in both daily practices and cultural evolution is best demonstrated by the fact that as early as the 7th century BC, olive oil constituted a topic of research and investigation for the ancient Greek philosophers, who examined both its nutritional and medicinal properties. Both Aristotle and Hippocrates recognized the beneficial properties of olive oil and recommended its ingestion and use as ointments for the treatment of diseases, such as stomach and dermatological ulcers.

N.N. Nomikos, G.N. Nomikos, D.S. Kores. The use of deep friction massage with olive oil as a means of prevention and treatment of sports injuries in ancient times. Arch. Med. Sci., 6 (5) (2010), pp. 642-645

European Parliament
The EU Olive and Olive Oil Sector. Main Features, Challenges and Prospects
retrieved from: (2017) http://www.agro-alimentarias.coop/ficheros/doc/05461.pdf

Worldwide production and profile

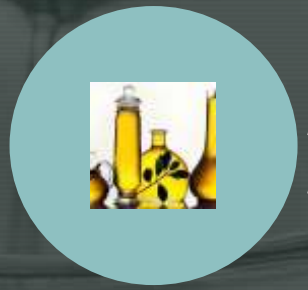
Currently, approximately 70% of olive oil production is undertaken in Mediterranean countries, including Spain, Turkey, Greece, Italy, Morocco, and Tunisia. However, olive oil is also produced in other regions of the world, including Australia and the USA. Since distinct polyphenol profiles are detected even between different olive oil types produced within a single country, diverse varieties of olive oil, with differing qualities, exist. Nutritional attributes also vary depending on the subtypes of olive oil.

Greece & olive oil

- The third olive oil producing country in the world after Spain and Italy
- About 16% of the global annual production of which 80% is extra virgin oil.
- Superior quality with significant diversity, domestic diversification and recognized nutritional value

A fact!

Many studies have acknowledged olive oil as a healthy food with multiple utilities and benefits for the human body



(Preddy and Watson, 2010;Foskolou et al 2018; Antoniadou & Varzakas 2020).

Aim

To present the key aspects of Olive Oil (virgin-VOO) such as processing, quality, safety, authenticity, nutritional, health and oral health aspects.

Production methods of olive oil

Virgin olive oil is produced by direct pressing or centrifugation of the olives. Virgin olive oils with acidity level greater than or equal to 3.3 degrees (International Olive Oil Council Regulation/T.15/NC.n3.Rev2. Nov 24, 2006), or 2 degrees in Europe (European Regulation N. 1513/0) are submitted to a refining process in which some components, mainly phenolic compounds, and to a lesser degree, squalene, are lost.

By mixing virgin and refined olive oil an ordinary olive oil is produced and marketed. After virgin olive oil production the rest of the olive drupe and seed is again processed, submitted to a refining process, and the resulting pomace olive oil, to which a certain quantity of virgin olive oil is added, is put on the market.

Composition of Olive Oil

The composition of olive oil is primarily triacylglycerols (~99%) and secondarily free fatty acids, mono- and diacylglycerols, and an array of lipids such as hydrocarbons, sterols, aliphatic alcohols, tocopherols, and pigments. A plethora of phenolic and volatile compounds are also present. Some of these compounds contribute to the unique character of the oil. Fatty acids present in olive oil are palmitic (C16:0), palmitoleic (C16:1), stearic (C18:0), oleic (C18:1), linoleic (C18:2), and linolenic (C18:3). Myristic (C14:0), heptadecanoic, and eicosanoic acids are found in trace amounts.

Olive oil subtypes

There exist several olive oil subtypes (i.e. extra virgin olive oil, virgin olive oil, refined olive oil, and pomace oil) which exhibit differential potential impacts upon human health.

M. Gorzynik-Debicka, P. Przychodzen, F. Cappello, A. Kuban-Jankowska, A. Marino Gammazza, N. Knap, M. Wozniak, M. Gorska-Ponikowska. Potential health benefits of olive oil and plant polyphenols Int. J. Mol. Sci., 19 (3) (2018), 10.3390/ijms19030686

Health aspects

Virgin olive oil (VOO), contains the oleic acid and other polyphenolic compounds such as hydroxytyrosol (HT) and hydroxytyrosol acetate (HT-AC), shown to have clear antioxidant effects.

(Antoniadou & Varzakas 2020).

Phenolic compounds of EVOO

Phenolic compounds can be divided into three groups:

- simple phenols (i.e., tyrosol, hydroxytyrosol or 3,4-dihydroxyphenylethanol),

- phenolic acids (i.e., caffeic acid),

- flavonoids (i.e., quercetin).

Results from oil consumption in the Med-diet

- Inhibition of platelet aggregation,
- Inhibition of oxidation of Low-Density Lipoproteins (LDLs),
- Stimulation of Nitric Oxide (NO) production
- Down regulation of the expression of endothelial adhesion molecules.

Heart Disease

Studies consistently link a diet high in monounsaturated fat with favorable effects on markers of cardiovascular disease (heart disease and stroke).

This includes a reduction in markers of chronic inflammation, blood pressure, cholesterol levels and blood glucose levels.

(WHO 2020).

Stroke

Stroke is the second largest killer after CVDs. It's closely linked to heart disease and shares many of the same risk factors, such as high cholesterol and high blood pressure.

With olive oil, 26% lower risk of stroke.

M.A. Martínez-González, L.J. Dominguez, M. Delgado-Rodríguez Olive oil consumption and risk of CHD and/or stroke: a meta-analysis of case-control, cohort and intervention studies. Br. J. Nutr., 112 (2) (2014), pp. 248-259.

Diabetes

The phenolic compounds present in EVOO aid in glucose metabolism and improve the sensitivity and effectiveness of insulin.

More specifically, olives contain oleuropein, a compound that signals the pancreas to release insulin, helping regulate the blood sugar levels and metabolism. This explains the reduction of the risk of diabetes type 2 with a regular consumption of VOO by 9%.

Schwingshackl et al. 2017

Cancer

Facts

-Observational studies have shown a lower incidence of some cancers in regions where olive oil consumption is high (Grosso et al 2017).

-Phenols of EVOO (extra virgin olive oil) are its most studied components with recognized antitumor properties.

-It is still unclear whether olive oil's monounsaturated fatty acid content or its antioxidant components are responsible for its beneficial effects.

3 meta-analysis on Cancer and Olive oil

- T. Psaltopoulou, R.I. Kosti, D. Haidopoulos, M. Dimopoulos, D.B. Panagiotakos. Olive oil intake is inversely related to cancer prevalence: a systematic review and a meta-analysis of 13800 patients and 23340 controls in 19 observational studies. Lipids Health Dis., 10 (2011), p. 127, 10.1186/1476-511X-10-127
- C. Pelucchi, C. Bosetti, E. Negri, L. Lipworth, C. La Vecchia. Olive oil and Cancer risk: an update of epidemiological findings through 2010. Curr. Pharm. Des., 17 (8) (2011), pp. 805-812, 10.2174/138161211795428920
- Y. Xin, X.-Y. Li, S.-R. Sun, L.-X. Wang, T. Huang. Vegetable oil intake and breast cancer risk: a meta-analysis. Asian Pac. J. Cancer Prev., 16 (12) (2015), pp. 5125-5135

Other components with anti-tumor properties

Apigenin (in the subclass of flavonoids) : anti-tumor properties in colorectal, liver, breast, lung, and prostate cancer, with low toxicity and no mutagenic activity.

Luteolin (another natural flavonoid): different beneficial properties on inflammation, oxidation, and cancers too.

Maslinic acid (a triterpene found at high levels in the waxy skin of olives): prevention of chronic inflammatory response, which is involved in carcinogenesis.

Oleic acid : more resistance to oxidation than the polyunsaturated fatty acids. It is highlighted then that oleic acid, linoleic acid and squalene could have a tumor-inhibiting role.

Autoimmune diseases

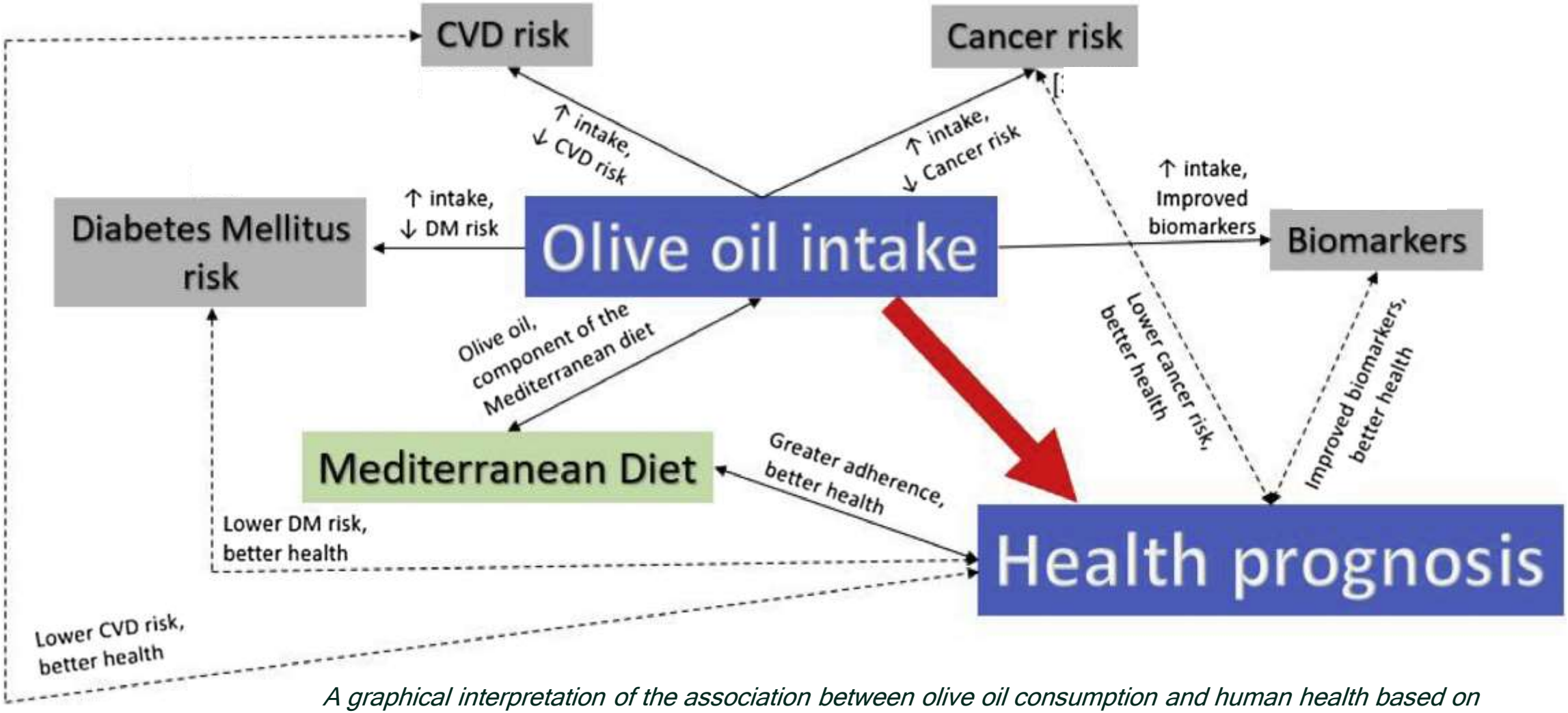
The immunomodulatory properties could reduce chronic inflammation in other immune-mediated pathologies, such as multiple sclerosis, psoriasis, rheumatoid arthritis, systemic lupus erythematosus and inflammatory bowel diseases.

Anti-aging properties of olive oil

The interaction between gut microbiota and olive oil consumption could modulate colonic microbial composition or activity, with a possible role in cancer prevention. Gut microbiota can degrade some substances found in olive oil, producing active metabolites with chemo-preventive action. These beneficial findings correspond to the relevance of EVOO with antiaging and anticancer properties assigned to it.

Brain health

Olive oil could potentially reduce the risk of Alzheimer's disease and age-related dementia. The phenolic components of oil may help clear the compounds that cause brain degeneration. Many studies showed that hydroxytyrosol (HT) has despite antitumor effects, some significant anti-inflammatory ones which improve the endothelial cell function, the protective effect on liver steatosis and neuroprotective effects.



A graphical interpretation of the association between olive oil consumption and human health based on the 10 meta-analysis articles used in the study of Foskolou et al 2018.

Oral health - The role of saliva

When the natural “cleaner” of the oral cavity -the saliva- is diminished or absent due to age, chemotherapy, drugs etc, the risk of dental caries arises.

- There is no chemical protection from the acids of the food consumed.
- There is no antibacterial protection

Xerostomia

Olive oil as a physical lubricant of the xerostomic cavity, can have a healing effect in xerostomia and general hyposalivation of the mouth which causes dental caries. Either by food consuming or by oil pulling, olive oil can have a therapeutic effect in all oral soft and hard tissues either directly or indirectly.

Olive oil & Dental erosion

Olive oil may indirectly contribute to the health of hard dental tissues in cases of erosion in the mouth of geriatric patients or younger ones with specific erosive habits due to the supportive influence of the oleic acid or through the better absorption of vitamin E and C which are known for beneficial attributes in the oral cavity.

This is a promising research field since there are so far contradictory in vitro and yet no clinical data.

(Ionta et al 2017; Antoniadou 2018; Antoniadou and Varzakas 2020).

Dental caries, periodontitis & Olive oil

Olive oil, rich in oleic acid and other phenolic compounds, is useful for enhancing fluoride inhibition of extracellular polysaccharide (EPS) formation by *Streptococcus mutans* and has a role in preventing biofilm formation. The acids add hydrophobic characteristics to the tooth surface hampering bacterial colonisation and eventually decreasing caries susceptibility. Therefore olive oil, which is rich in oleic acid, may be useful in the prophylaxis of dental caries and periodontitis to promote oral health.

Cai J N, Kim M A, Jung J E, Pandit S, Song K Y, Jeon J G. Effects of combined oleic acid and fluoride at sub-MIC levels on EPS formation and viability of Streptococcus mutans UA159 biofilms. Biofouling 2015; 31: 555-563.

Pan S W, Li YG, Su H, Li X, Zhang Y B. Oleic acid impedes adhesion of Porphyromonas gingivalis during the early stages of biofilm formation. Int J Clin Exp Med 2019; 12: 9881-9889.

Conclusions

- This presentation gave a narrative review of the effect of olive oil on human health in general and oral health more specifically.
- Consumption of pure olive oil benefits human health.
- Olive oil has beneficial effects on the cardiovascular system and reduce the risk of stroke.
- Olive oil can help to prevent cancer and diabetes mellitus.
- Olive oil has the potential to prevent dental erosion and caries. More research is needed on these fields.

Thank you

for your attention !

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