The Science & Health Benefits of Extra Virgin Olive Oil

Dr Joanna McMillan
Nutrition Scientist,
Dietitian & Food Futurist

DISCLAIMER

I have consulted to Cobram Estate Olives for more than a decade and joined the board as a non-executive director in 2021

WHAT'S IN EVOO?

FATS
Principally oleic acid

TOCOPHEROLS
(vitamin E)

PHYTOSTEROLS
beta-sitosterol is main one, but many others

MINOR COMPONENTS
carotenoids & chlorophyllic pigments = colour
volatile compounds = smell

POLYPHENOLS

phenolic acids
e.g. p-coumaric, gallic, vanillic, caffeic acid

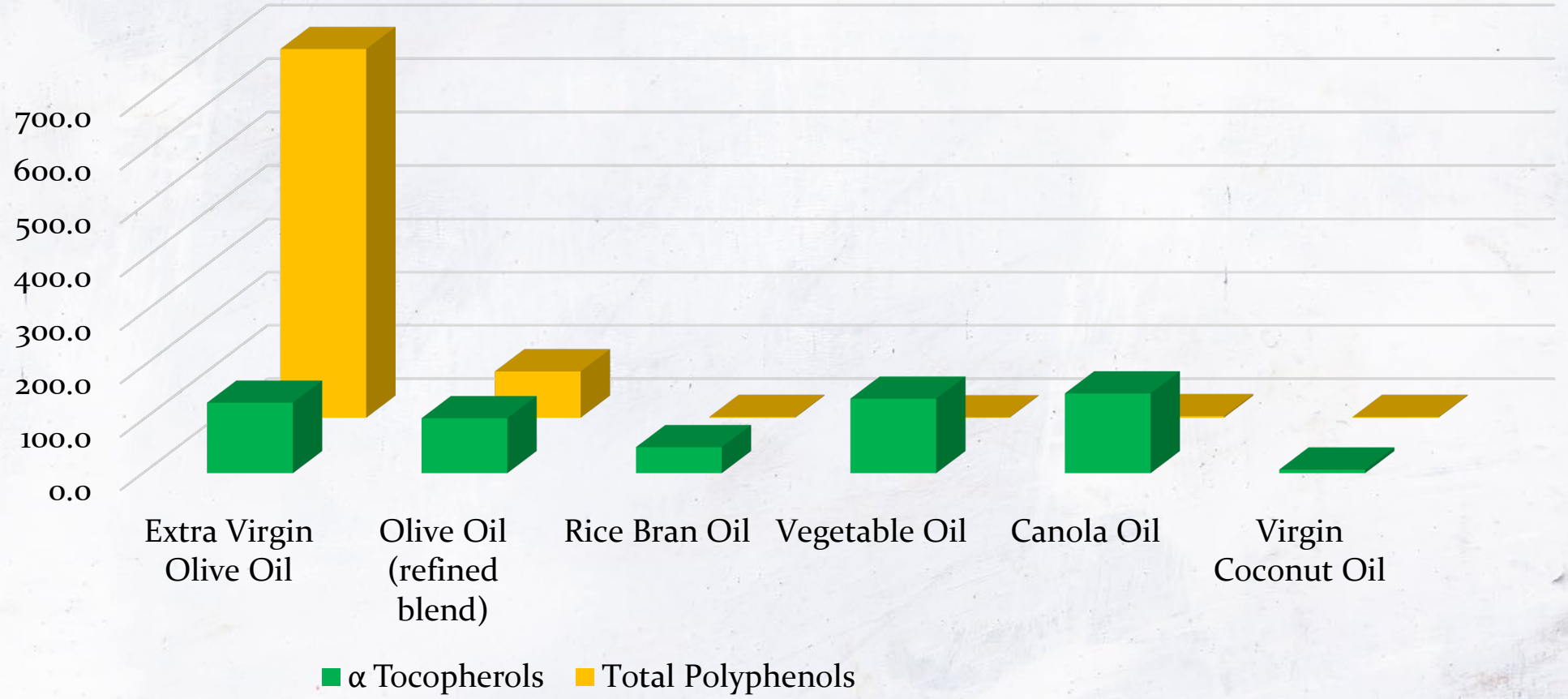
flavonoids
e.g. luteolin, apigenin & derivatives

lignans
e.g. pinoresinol, 1-acetoxypinoresinol

secoiridoids
e.g. oleuropein, ligstroside, oleocanthal

phenolic alcohols
e.g. tyrosol, hydroxytyrosol

Polyphenols & Vit E in Common Oils



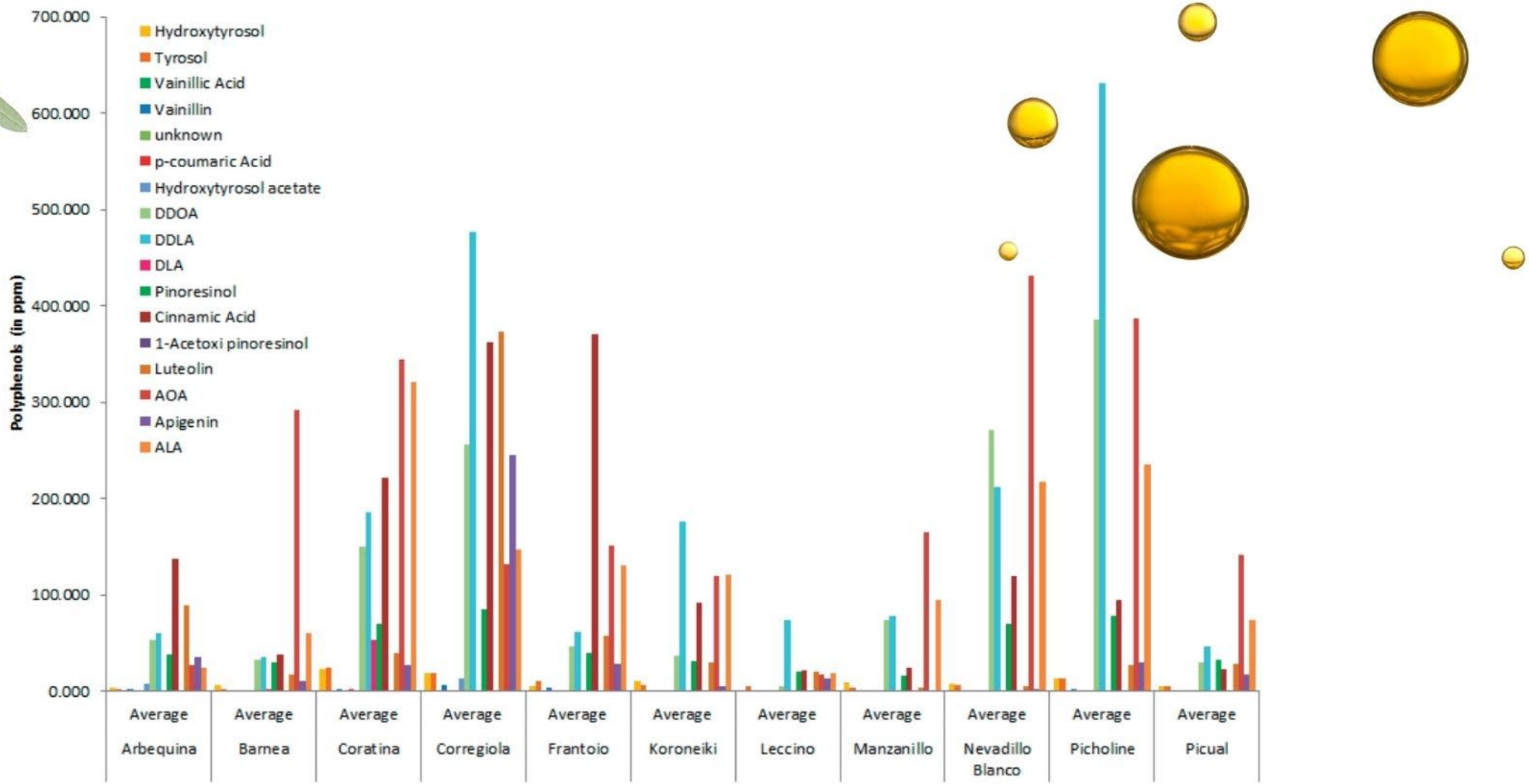
FAT PROFILE OF EVOO

	Olive cultivar[a]					
	Fuentes et al. (2018)[38]		Montaño et al. (2016)[39]		Di Lecce et al. (2020)[40]	
Reference	Coratina	Leccino	Arbequina	Picual	Kalamata	Koroneiki
Fatty acid methyl ester composition (%)						
C16:0 Palmitic acid	13.60 ± 0.6	13.7 ± 0.7	15.3 ± 1.4	11.6 ± 1.2	15.6±0.1	10.6±0.0
C16:1 Palmitoleic acid	1.2 ± 0.3	1.3 ± 0.2	1.6 ± 0.2	1.0 ± 0.2	2.2 ±0.1	0.6±0.0
C18:0 Stearic acid	1.91 ± 0.30	1.7 ± 0.2	1.3 ± 0.5	2.0 ± 0.9	2.2 ±0.1	2.5 ±0.00
C18:1 Oleic acid	78.8 ± 3.9	76.7 ± 4.1	67.3 ± 4.3	80.7 ± 2.0	68.7 ±0.1	79.2±0.1
C18:2 Linoleic acid	4.8 ± 0.3	6.0 ± 0.4	12.7 ± 2.6	3.1 ± 0.5	10.0±0.1	5.3±0.0
C18:3 α-Linolenic acid	0.6 ± 0.1	0.7 ± 0.1	0.6 ± 0.1	0.7 ± 0.1	0.10 ±0.1	Not detected

[a]Data are expressed as mean ± SD.

Millman et al. (2021) Nutrition Reviews 79(12):1362-74

Polyphenol Profiles of Australian Olive Cultivars



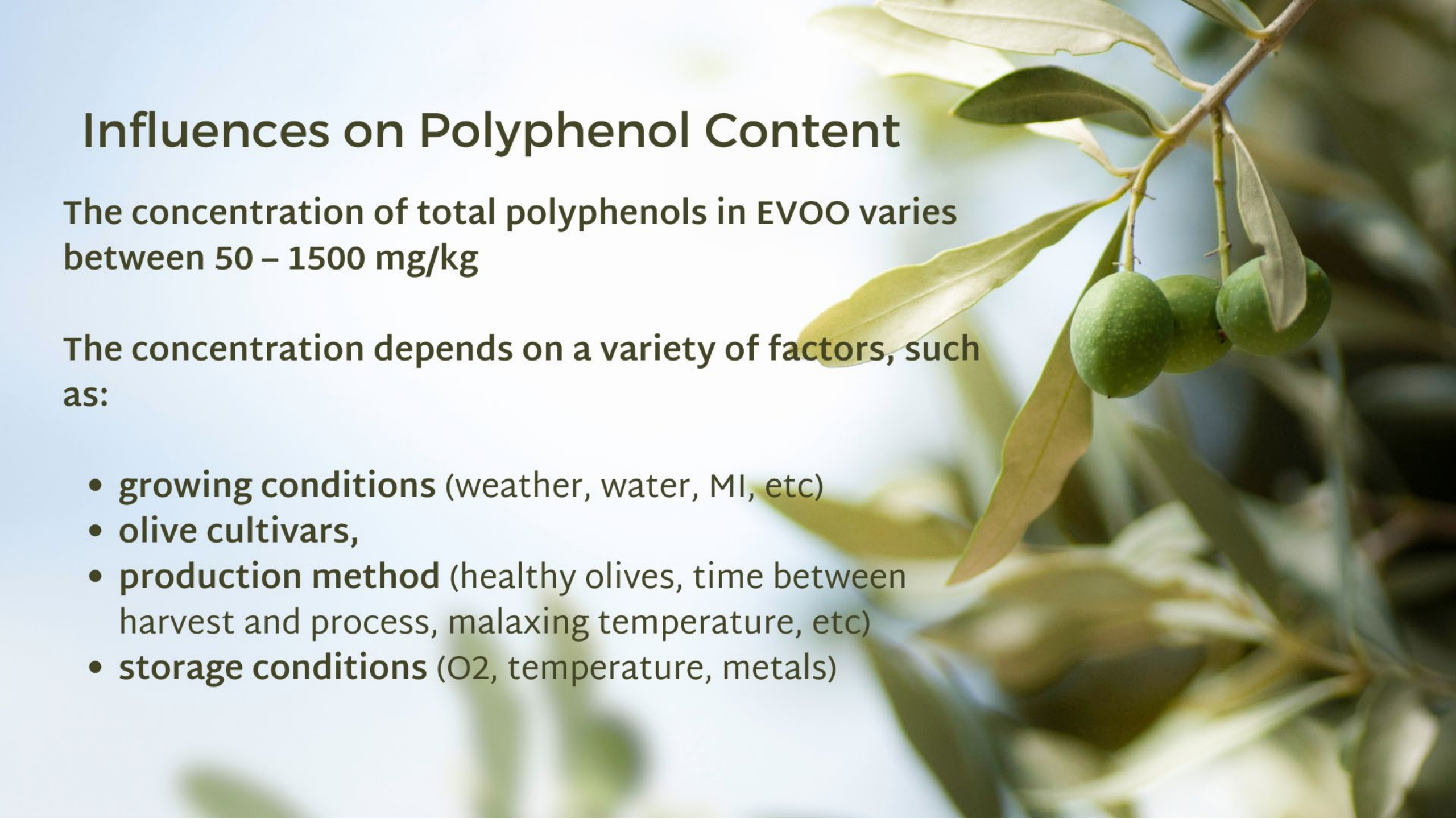
RIRDC Publication No.13/094 (2013)

Influences on Polyphenol Content

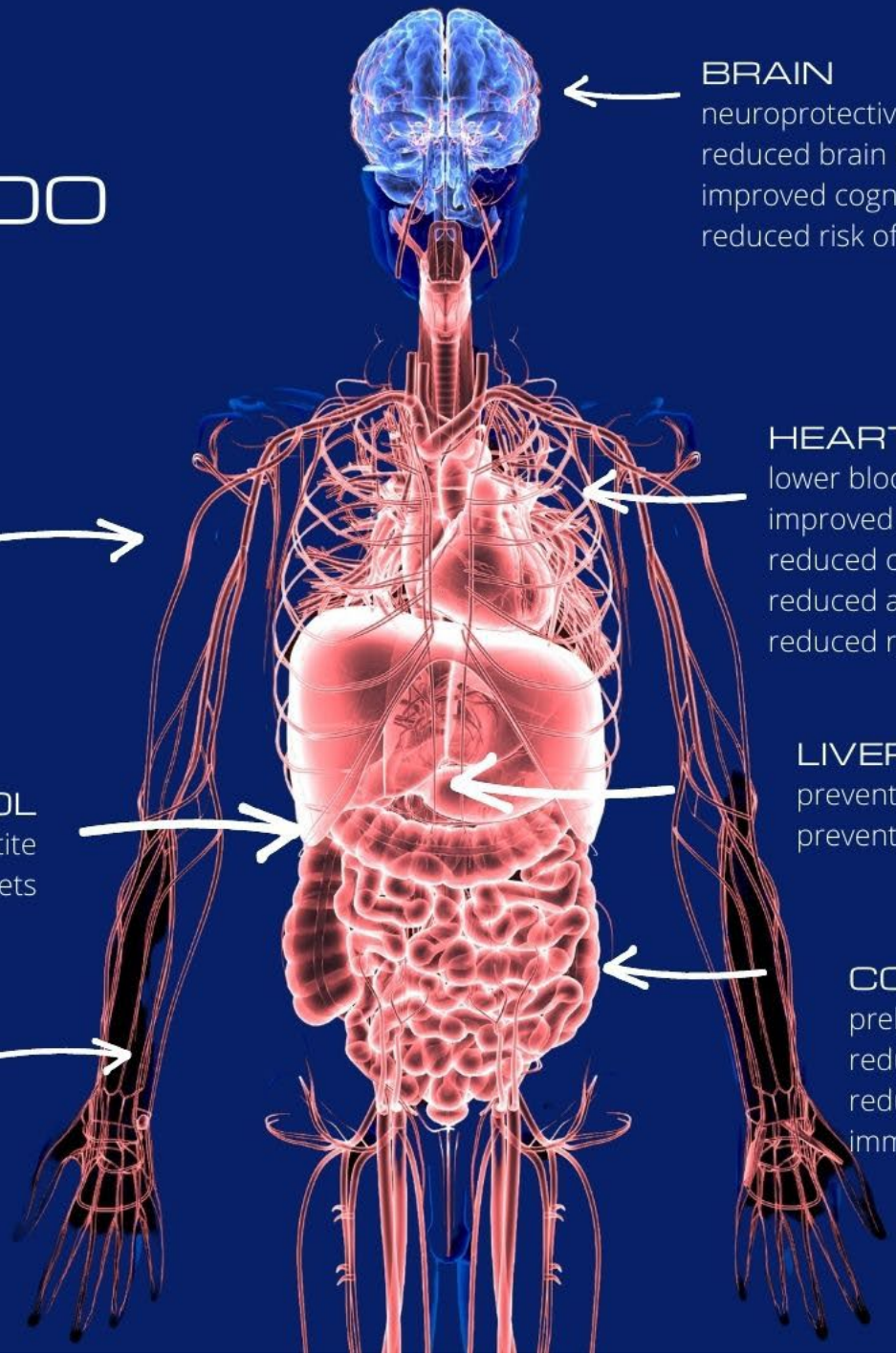
The concentration of total polyphenols in EVOO varies between 50 – 1500 mg/kg

The concentration depends on a variety of factors, such as:

- **growing conditions** (weather, water, MI, etc)
- **olive cultivars,**
- **production method** (healthy olives, time between harvest and process, malaxing temperature, etc)
- **storage conditions** (O2, temperature, metals)



Summary of Health Benefits of EVOO



BRAIN
neuroprotective
reduced brain inflammation
improved cognition
reduced risk of neurodegenerative disorders

HEART
lower blood pressure
improved blood lipids
reduced oxidised LDL
reduced atherosclerosis progression
reduced risk of CVD

LIVER
prevention & treatment of NAFLD
prevention & resolution of liver damage

COLON / GUT
prebiotic effects on gut microbiome
reduced risk of colon cancer
reduced inflammation
immune benefits

GLUCOSE & INSULIN
improved insulin sensitivity
improved HBA1C
reduced fasting glucose & post-prandial glucose excursions
reduced risk of T2D

WEIGHT CONTROL
oleoylethanolamide (OEA) induces satiety & reduction in appetite
reduces weight & waist circumference cf control diets

VASCULAR
reduced biomarkers of inflammation
reduced oxidative stress markers
improved endothelial function

OLEOCANTHAL
Anti-inflammatory & anticancer

> Exp Neurol. 2020 Jun;328:113248. doi: 10.1016/j.expneurol.2020.113248. Epub 2020 Feb 19.

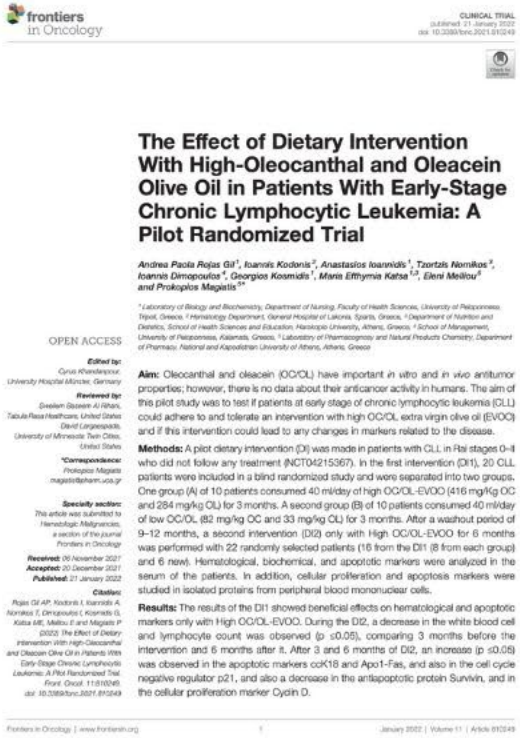
Purified oleocanthal and ligstroside protect against mitochondrial dysfunction in models of early Alzheimer's disease and brain ageing

Rekha Grewal [1], Martina Reutzel [1], Benjamin Dilberger [1], Hannah Hein [1], Jens Zotzel [2], Stefan Marx [2], Joachim Tretzel [2], Alla Sarafeddinov [2], Christopher Fuchs [2], Gunter P Eckert [3]

> J Oleo Sci. 2022;71(8):1199-1206. doi: 10.5650/jos.ess22008.

Impact of Olive Oil Constituents on C-reactive Protein: In silico Evidence

Hidayat Ur Rahman [1 2], Muhammad Hamdi Mahmood [1], Najm Us Sama [3], Muhammad Afzal [4], Mohd Razip Asaruddin [5], Mohammed Safwan Ali Khan [6 7]



frontiers in Oncology

CLINICAL TRIAL

The Effect of Dietary Intervention With High-Oleocanthal and Oleacein Olive Oil in Patients With Early-Stage Chronic Lymphocytic Leukemia: A Pilot Randomized Trial

OPEN ACCESS

Aim: Oleocanthal and oleacein (OC/OL) have important *in vitro* and *in vivo* antitumor properties; however, there is no data about their anticancer activity in humans. The aim of this pilot study was to test if patients at early stage of chronic lymphocytic leukemia (CLL) could adhere to and tolerate an intervention with high OC/OL extra virgin olive oil (EVOO) and if this intervention could lead to any changes in markers related to the disease.

Methods: A pilot dietary intervention (DI) was made in patients with CLL in Rai stages 0–II who did not follow any treatment (NCT04215367). In the first intervention (DI1), 20 CLL patients were included in a blind randomized study and were separated into two groups. One group (A) of 10 patients consumed 40 ml/day of high OC/OL-EVOO (416 mg/Kg OC and 284 mg/kg OL) for 3 months. A second group (B) of 10 patients consumed 40 ml/day of low OC/OL (82 mg/kg OC and 33 mg/kg OL) for 3 months. After a washout period of 9–12 months, a second intervention (DI2) only with High OC/OL-EVOO for 6 months was performed with 22 randomly selected patients (16 from the DI1 (8 from each group) and 6 new). Hematological, biochemical, and apoptotic markers were analyzed in the serum of the patients. In addition, cellular proliferation and apoptosis markers were studied in isolated proteins from peripheral blood mononuclear cells.

Results: The results of the DI1 showed beneficial effects on hematological and apoptotic markers only with High OC/OL-EVOO. During the DI2, a decrease in the white blood cell and lymphocyte count was observed ($p \leq 0.05$), comparing 3 months before the intervention and 6 months after it. After 3 and 6 months of DI2, an increase ($p \leq 0.05$) was observed in the apoptotic markers ccK18 and Apo1-Fas, and also in the cell cycle negative regulator p21, and also a decrease in the antiapoptotic protein Survivin, and in the cellular proliferation marker Cyclin D.

cancers

MDPI

Article

Oleocanthal Attenuates Metastatic Castration-Resistant Prostate Cancer Progression and Recurrence by Targeting SMYD2

Simple Summary: The Mediterranean, extra-virgin-olive-oil-rich diet ingredient *S*-(-)-oleocanthal (OC) has emerged as a potential inhibitor for the growth and relapse of the most aggressive prostate cancer type. This effect is mediated through suppression of important enzyme, SMYD2, that drives the activation of several downstream protein effectors. OC treatments reduced SMYD2 downstream substrates, which are critical for prostate cancer growth and relapse. OC is more advantageous than other reported SMYD2 inhibitors because it has shown potent anticancer activity in animal models. OC's anti-prostate-cancer effect was prominent compared with some standard drugs currently used to control prostate cancer. OC is a potential, novel-natural compound appropriate for immediate use by prostate cancer patients and survivors as a nutraceutical or dietary supplement product.

Abstract: Metastatic castration-resistant prostate cancer (mCRPC) is the most aggressive prostate cancer (PC) phenotype. Cellular lysine methylation is driven by protein lysine methyltransferases (PKMTs), such as those in the SET- and MYND-containing protein (SMYD) family, including SMYD2 methylatic, and several histone and non-histone proteins. SMYD2 is dysregulated in metastatic PC patients with high Gleason score and shorter survival. The Mediterranean, extra-virgin-olive-oil-rich diet ingredient *S*-(-)-oleocanthal (OC) inhibited SMYD2 in biochemical assays and suppressed viability, migration, invasion, and colony formation of PC-3, CWR-R1ca, PC-3M, and DU-145 PC cell lines with IC_{50} range from high nM to low μM. OC's in vitro antiproliferative effect was comparable to standard anti-PC chemotherapies or hormone therapies. A daily, oral 10 mg/kg dose of OC for 11 days effectively suppressed the progression of the mCRPC CWR-R1ca cells engrafted into male nude mice. Daily, oral OC treatment for 30 days suppressed tumor locoregional and distant recurrences after the primary tumors' surgical excision. Collected OC-treated animal tumors showed marked SMYD2 reduction. OC-treated mice showed significant serum PSA reduction. For the first time, this study showed SMYD2 as novel molecular target in mCRPC, and OC emerged as a specific SMYD2 lead inhibitor. OC prevailed over previously reported SMYD2 inhibitors, with validated in vitro potency and high safety profile, and, therefore, is proposed as a novel nutraceutical for mCRPC progression and recurrence control.

Keywords: castration-resistant; prostate cancer; extra-virgin olive oil; nutraceutical; oleocanthal; progression; recurrence; SMYD2

1. Introduction

Prostate cancer (PC) is the most prevalent cancer among elderly men worldwide. It is the second leading cause of cancer death in American men. In 2020, the global incidence

REVIEW

WILEY

Anticancer molecular mechanisms of oleocanthal

Mohammed El Haouari[1,2] | Juan E. Quintero[3] | Juan A. Rosado[3]

[1]Laboratoire d'Ingénierie Pédagogique et Didactique des Sciences (IPDSM), Centre Régional des Métiers de l'Education et de la Formation (CRMEF Fès-Meknès), Taza, Morocco

[2]Laboratoire Substances Naturelles, Pharmacologie, Environnement, Modélisation, Santé & Qualité de vie (SNAMOPEQ), Faculté Polydisciplinaire de Taza, Université Sidi Mohamed Ben Abdellah, Taza, Morocco

[3]Department of Physiology (Cell Physiology Research Group), Institute of Molecular Pathology Biomarkers, University of Extremadura, Cáceres, Spain

Correspondence
Mohammed El Haouari, Centre Régional des Métiers de l'Education et de la Formation Fès-Meknès (Antenne de Taza), B.P: 1178, Taza Gare, Taza, Morocco.
Email: elhouarim@yahoo.fr

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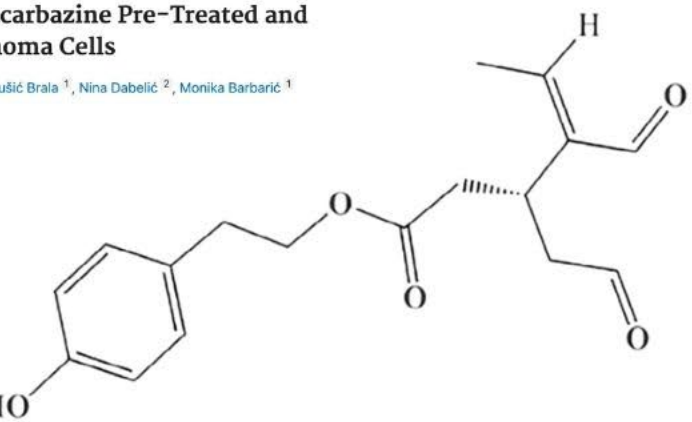
Cancer is among the leading causes of mortality worldwide. Current cancer therapies are associated with serious side effects, which further damage patients' health. Therefore, the search for new anticancer agents with no toxic effects on normal and healthy cells is of great interest. Recently, we and other groups have demonstrated that oleocanthal (OLC), a phenolic compound from extra virgin olive oil, exhibits anti-tumor activity in various tumor models. However, the underlying mechanisms and intracellular targets of OLC remain to be completely elucidated. This review summarizes the current advancers concerning the anticancer activity of OLC, with particular emphasis on the molecular signaling pathways modulated by this compound in different tumor cell types. The major mechanisms of action of OLC include modulation of the apoptotic pathway, the HGF/c-Met pathway, and the signal transducer and activator of transcription 3 signaling pathway, among others. Furthermore, OLC has synergistic effects with anticancer drugs in vitro. Also discussed are OLC bioavailability and its concentration in olive oil. Data summarized here will represent a database for more extensive studies aimed at providing information on molecular mechanisms against cancer induced by OLC.

KEYWORDS
(−)-oleocanthal, antiinflammatory, antioxidant, apoptosis, cancer, extra virgin olive oil, HGF/c-met, signal transduction, STAT3

> Molecules. 2022 May 21;27(10):3310. doi: 10.3390/molecules27103310.

Extra Virgin Olive Oil Secoiridoids Modulate the Metabolic Activity of Dacarbazine Pre-Treated and Treatment-Naive Melanoma Cells

Azra Kugić [1], Sanja Dabelić [1], Cvijeta Jakobušić Brala [1], Nina Dabelić [2], Monika Barbarić [1]



OLEUROPEIN
NEUROPROTECTIVE, ANTIOXIDANT, ANTICANCER, ANTIINFLAMMATORY

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DOI: 10.1111/jfbc.13967

REVIEW

Journal of Food Biochemistry WILEY

Neuroprotective effects of oleuropein: Recent developments and contemporary research

Masood Sadiq Butt[1] | Urwa Tariq[1] | Iahtisham-Ul-Haq[2] | Ambreen Naz[3] | Muhammad Rizwan[2]

[1]Faculty of Food, Nutrition and Home Sciences, National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan
[2]Faculty of Life Sciences, Department of Food Science and Technology, University of Central Punjab, Lahore, Pakistan
[3]Department of Food Science and Technology, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan

Correspondence
Iahtisham-Ul-Haq, Department of Food Science and Technology, Faculty of Life Sciences, University of Central Punjab, Lahore, Pakistan.
Email: iahtisham@hotmail.com

Abstract

Neurological disorders are increasing at a faster pace due to oxidative stress, protein aggregation, excitotoxicity, and neuroinflammation. It is reported that the Mediterranean diet including olives as a major dietary component prevents and ameliorates neurological anomalies. Oleuropein is the major bioactive component in different parts of the Olive (*Olea europaea* L.) tree. Several mechanisms have been reported for the neuroprotective role of oleuropein including induction of apoptosis and autophagy, enhancing the antioxidant pool of the cerebral region, decreasing the unnecessary release of proinflammatory cytokines and chemokines by deactivating the microglia cells and astrocytes thus preventing the occurrence of neuroinflammation. Regular intake of oleuropein seems to be correlated with decreased risks of neural disorders including Alzheimer's, Parkinson's, strokes, depression, anxiety, epilepsy, and others. This review majorly discusses the chemistry, biosynthesis, and metabolism of oleuropein along with an updated vision of its neuroprotective role in counteracting the acute and chronic neurodegenerative and neuropsychiatric disorders. Moreover, mechanisms by which oleuropein may prevent neurodegeneration are reviewed.

> Asian Pac J Allergy Immunol. 2022 Aug 22. doi: 10.12932/AP-200122-1309.
Online ahead of print.

Oleuropein attenuates inflammation and regulates immune responses in a 2,4-dinitrochlorobenzene-induced atopic dermatitis mouse model

Wen-Chung Huang [1 2], Chian-Jiun Liou [2 3], Szu-Chuan Shen [4], Sindy Hu [5 6], Jane C-J Chao [7], Chun-Hsun Huang [5 6], Shu-Ju Wu [6 8]

Review > Life (Basel). 2022 Jul 28;12(8):1140. doi: 10.3390/life12081140.

A Comprehensive Review on the Anti-Cancer Effects of Oleuropein

Sabreen Rishmawi [1], Fatma Haddad [1 2], Ghadeer Dokmak [1], Rafik Karaman [1 3]

Affiliations + expand

PMID: 36013319 PMCID: PMC9409738 DOI: 10.3390/life12081140
Free PMC article

Abstract

In Mediterranean cuisine and culture, olive oil and olive fruits play a significant role. Many people believe that those who consume olive oil and its fruit live longer and have a decreased risk of illness. Olive leaves were used to treat a range of diseases in ancient times, including malaria fever and lower earaches. Although it was not understood at the time what key components were responsible for these effects because they had not yet been discovered, Oleuropein is now recognized as one of the primary elements in immature olive fruits and leaves. Later research was carried out to determine the effects of this molecule, and it was determined that it functions as an antioxidant. Oleuropein consumption has aided in cancer treatment over the years, and this was assumed to be owing to its antioxidant properties. Oleuropein's effects on cancer, however, go beyond that; it is now known that Oleuropein functions as both an anti-proliferative and an apoptotic promoter in many cancer cells. The kinetics and dosages of Oleuropein and the mechanisms behind its involvement and effects in cancer are explored in this review. Finally, the effects of Oleuropein in combination with anticancer medicines are investigated.

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DOI: 10.1002/ptr.6511

REVIEW

WILEY

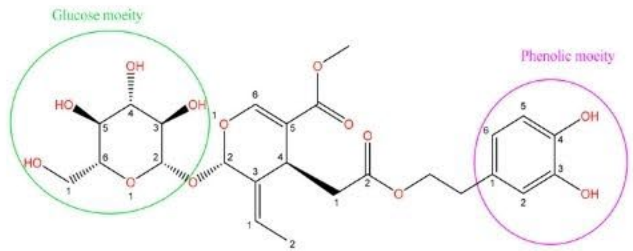
Oleuropein: A natural antioxidant molecule in the treatment of metabolic syndrome

Javed Ahamad[1] | Ibrahim Toufeeq[1] | Mohammad Ahmed Khan[2] | Muath Sh. Mohammed Ameen[1] | Esra T. Anwer[1] | Subha Uthirapathy[1] | Showkat R. Mir[3] | Javed Ahmad[4]

[1]Faculty of Pharmacy, Tishk International University, Erbil, Iraq
[2]Department of Pharmacology, School of Pharmaceutical Education and Research, Jamia Hamdard, New Delhi, India
[3]Department of Pharmacognosy, School of Pharmaceutical Education and Research (Formerly Faculty of Pharmacy), Jamia Hamdard, New Delhi, India
[4]Department of Pharmaceutics, College of Pharmacy, Najran University, Najran, Kingdom of Saudi Arabia

Correspondence
Javed Ahmad, Department of Pharmaceutics, College of Pharmacy, Najran University, Najran, Kingdom of Saudi Arabia.
Email: jahmad18@gmail.com

Olive (*Olea europaea* Linn., Fam. Oleaceae) is commonly known as *Zaytoon* in Mediterranean region. Its fruits and oil are essential components of Mediterranean diets. Olive tree is a prevalent plant species and one of the important cultivated crops of Mediterranean region. Oleuropein is a phenolic constituents of olive, which, along with its related compounds, has been indicated to be majorly responsible for its beneficial effects. Oleuropein is a secoiridoid type of phenolic compound and consists of three structural subunits: hydroxytyrosol, elenolic acid, and a glucose molecule. It is also reported to be the chemotaxonomic marker of olive. The oleuropein is reported to possess a number of biological activities including action against dyslipidemia, antiobesity, antidiabetic, antioxidant, antiatherogenic, antihypertensive, antiinflammatory, and hepatoprotective actions. The scientific evidence supports the role of oleuropein as a potential agent against metabolic syndrome. The present review discusses chemistry of oleuropein along with potential role of oleuropein with reference to pathophysiology of metabolic syndrome.

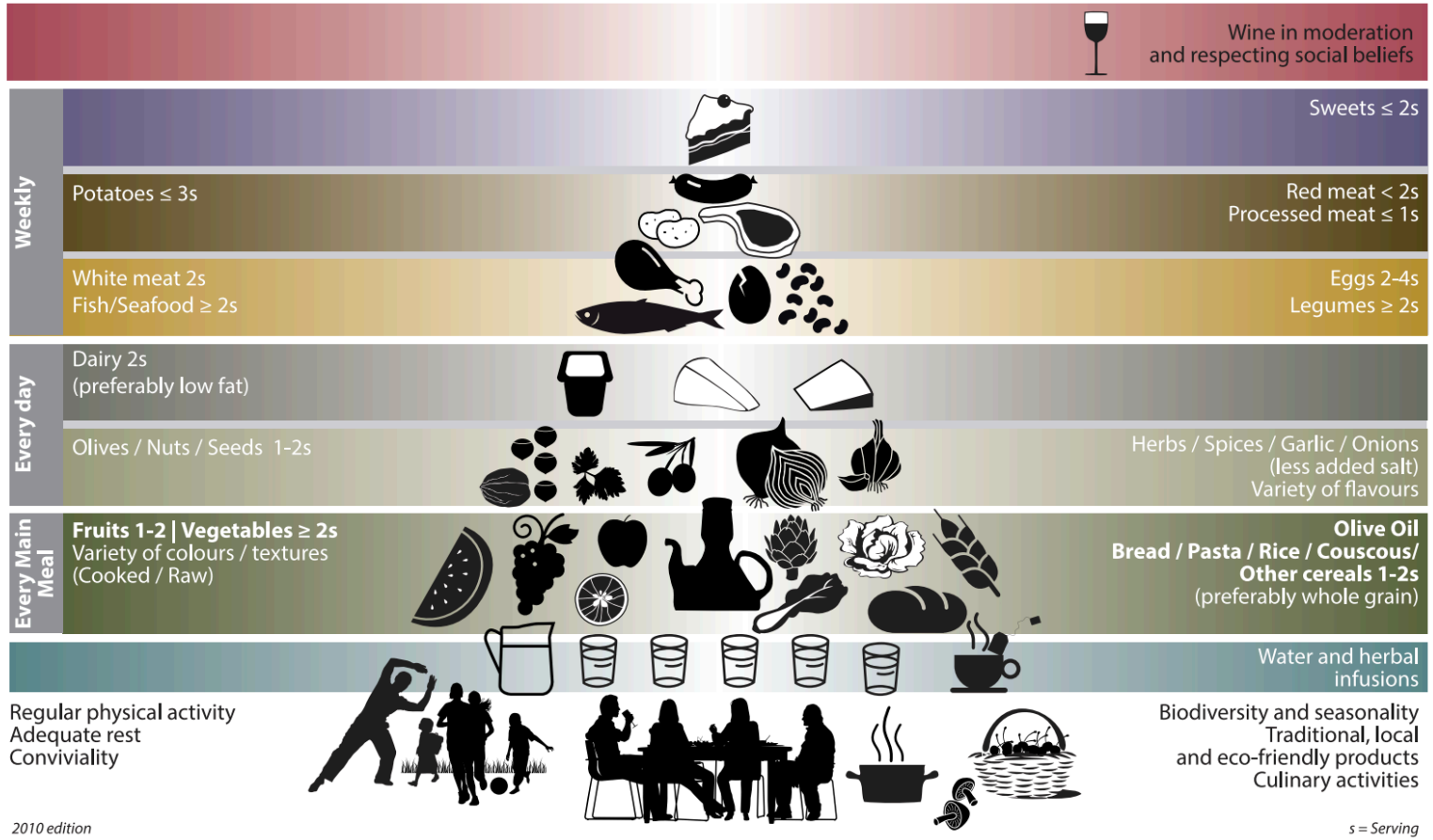


dr. Joanna

Mediterranean Diet Pyramid: a lifestyle for today

Guidelines for Adult population

Serving size based on frugality and local habits



Regular physical activity
Adequate rest
Conviviality

Biodiversity and seasonality
Traditional, local and eco-friendly products
Culinary activities

2010 edition

s = Serving

Fundación Dieta Mediterránea

ICAF International Commission on the Anthropology of Food and Nutrition

FORUM ON MEDITERRANEAN FOOD CULTURES

PrediMed Prevención con Dieta Mediterránea

Ciiscam

H.H.F. HELLENIC HEALTH FOUNDATION

IUNS

CIHEAM International Centre for Advanced Mediterranean Agronomic Studies

fens federation of european nutrition societies

dr. Joanna

EVOO & MED DIET

Stroke
Volume 52, Issue 11, November 2021; Pages 3440-3449
https://doi.org/10.1161/STROKEAHA.120.033214

CLINICAL TRIALS

Mediterranean Diet Reduces Atherosclerosis Progression in Coronary Heart Disease: An Analysis of the CORDIOPREV Randomized Controlled Trial

Jose Jimenez-Torres, MD *, Juan F. Alcalá-Diaz, MD, PhD *, Jose D. Torres-Peña, MD, PhD, Francisco M. Gutierrez-Mariscal, PhD, Ana Leon-Acuña, MD, PhD, Purificación Gómez-Luna, PhD, Carolina Fernández-Gandara, BS, Gracia M. Quintana-Navarro, BS, Jose C. Fernandez-Garcia, MD, PhD, Pablo Perez-Martinez, MD, PhD, Jose M. Ordovas, PhD, Javier Delgado-Lista, MD, PhD, Elena M. Yubero-Serrano, PhD †, and Jose Lopez-Miranda, MD, PhD †

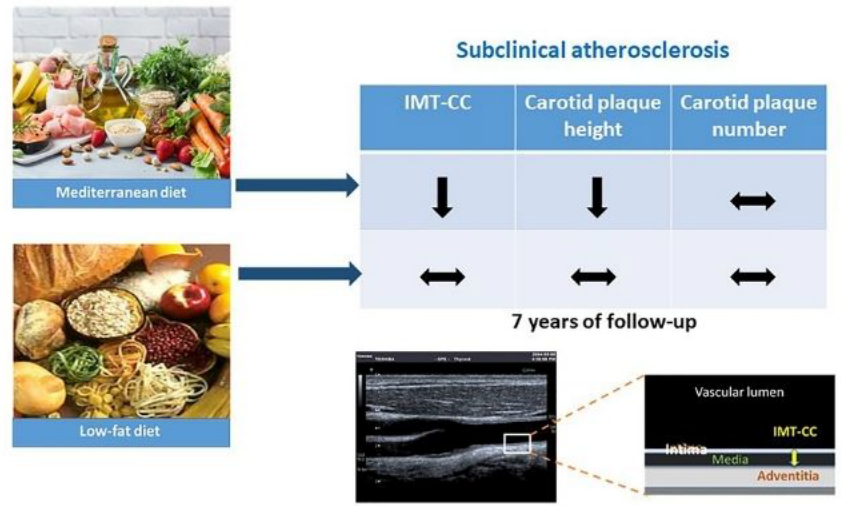
Lifestyle and diet affect cardiovascular risk, although there is currently no consensus about the best dietary model for the secondary prevention of cardiovascular disease. The CORDIOPREV study (Coronary Diet Intervention With Olive Oil and Cardiovascular Prevention) is an ongoing prospective, randomized, single-blind, controlled trial in 1002 coronary heart disease patients, whose primary objective is to compare the effect of 2 healthy dietary patterns (low-fat rich in complex carbohydrates versus Mediterranean diet rich in extra virgin olive oil) on the incidence of cardiovascular events. Here, we report the results of one secondary outcome of the CORDIOPREV study. Thus, to evaluate the efficacy of these diets in reducing cardiovascular disease risk. Intima-media thickness of both common carotid arteries (IMT-CC) was ultrasonically assessed bilaterally. IMT-CC is a validated surrogate for the status and future cardiovascular disease risk.

From the total participants, 939 completed IMT-CC evaluation at baseline and were randomized to follow a Mediterranean diet (35% fat, 22% monounsaturated fatty acids, <50% carbohydrates) or a low-fat diet (28% fat, 12% monounsaturated fatty acids, >55% carbohydrates) with IMT-CC measurements at 5 and 7 years. We also analyzed the carotid plaque number and height.

The Mediterranean diet decreased IMT-CC at 5 years (–0.027±0.008 mm; $P<0.001$), maintained at 7 years (–0.031±0.008 mm; $P<0.001$), compared to baseline. The low-fat diet did not modify IMT-CC. IMT-CC and carotid $plaque_{max}$ height were higher decreased after the Mediterranean diet, compared to the low-fat diet, throughout follow-up. Baseline IMT-CC had the strongest association with the changes in IMT-CC after the dietary intervention.

Long-term consumption of a Mediterranean diet rich in extravirgin olive oil, if compared to a low-fat diet, was associated with decreased atherosclerosis progression, as shown by reduced IMT-CC and carotid plaque height. These findings reinforce the clinical benefits of the Mediterranean diet in the context of secondary cardiovascular prevention.

URL: https://www.clinicaltrials.gov; Unique identifier: NCT00924937.



Graphical abstract: Effect of two healthy dietary patterns on IMT-CC and other subclinical atherosclerotic markers in patients with coronary heart disease.


How much do you need to benefit?
3 tablespoons (45ml)

EVOO & Weight Control

- PREDIMED – 3 year follow up almost no weight gain & lower waist circumference in Med diet + EVOO group (Razquin et al. 2009 EJCN 63:1387)
- Spanish review & meta-analysis found diet enriched with olive oil reduced weight more than control diet (Zamora Zamora F. et al. 2018 Rev Esp Salud Publica 92:21)
- Olive oil enriched diet brought greater weight loss than a lower-fat diet in overweight breast cancer survivors (Flynn & Reinert 2010 J Womens Health 19(6):1155)

JOANNA MCMILLAN

drjoanna.com

drjoannamcmillan