



**IOC scientific seminar on olive oil and health**  
**STATE OF THE ART IN OLIVE OIL, NUTRITION AND HEALTH**  
**7–8 March 2005**

**CONSENSUS STATEMENT**

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**Olive Oil and Cardiovascular Diseases**

**General points:**

The Mediterranean dietary model could incorporate new advances in nutrition, e.g. by including new healthy foods, while:

1. Maintaining the daily intake of the most important foods providing monounsaturated fat, fibre, antioxidants and omega-3: olive oil, whole-grain cereals, legumes, fresh fruits and vegetables and fish.
2. Preserving Mediterranean culinary methods.
3. Maintaining the timing (pattern) of meals.

**Specific points:**

The olive-oil-rich Mediterranean diet has the following identified health benefits:

1. When it replaces a diet high in saturated fat it decreases plasma levels of LDL-cholesterol and it improves the atherogenic LDL:HDL cholesterol ratio.
2. It reduces plasma triglycerides and increases HDL-cholesterol levels as compared with a low fat-high carbohydrate diet.

3. It improves postprandial lipoprotein metabolism.
4. When it replaces a high PUFA diet it decreases LDL susceptibility to oxidative modification.
5. It improves endothelial-dependent vasodilatation and inflammatory response.
6. It decreases platelet aggregation, postprandial activation of coagulation factor VII and plasma PAI-1 levels.
7. It improves carbohydrate metabolism in patients with Type-2 diabetes.
8. It lowers blood pressure and the risk of hypertension.
9. It does not promote obesity and it increases lipolytic activity in adipose tissue and UCP2 activity.

### **Areas to develop:**

The following needs have been identified to gain a further understanding and increased recognition of the health benefits of the Mediterranean diet and its main ingredients for the cardiovascular system:

1. To carry out large, well-controlled primary and secondary prevention intervention studies.
2. To understand the specific and differential healthy effects of olive oil micronutrients on atherogenesis.
3. To adapt the Mediterranean pyramid to local foods and to the taste preferences of different populations.
4. To use new technologies such as genomics and proteomics to gain a deeper insight into the molecular mechanism triggered by olive oil in order to promote its beneficial effects.
5. To study the impact of the global model of the Mediterranean diet (providing high monounsaturated fat) on obesity and metabolic syndrome.
6. To promote education about Mediterranean dietary habits in non-Mediterranean countries, especially among children, using new technological tools (i.e., web sites...).

## **Epidemiology of Olive Oil**

### **General points:**

1. Evidence from epidemiological studies relating the Mediterranean dietary pattern and more specifically the consumption of virgin olive oil with the primary prevention of cardiovascular disease is still limited.
2. There is supporting evidence from the Seven Countries Study associating a Mediterranean diet with a low mortality and incidence of cardiovascular diseases. However, case-control studies have been more controversial, although there is some support for the notion that higher olive oil consumption is associated with lower risk of myocardial infarction.
3. Cohort studies are also limited. In this regard, the EPIC study shows that closer adherence to the Mediterranean diet decreases the risk of cardiovascular diseases, although, in this study, the protection could not be attributed to any single dietary component.

4. Current epidemiological evidence suggests that there is a close-knit relationship between Mediterranean diet, olive oil consumption and cardiovascular risk.

**Areas to develop:**

1. Despite the promising evidence published so far, there is a need for more compelling evidence.
2. This will come from more case-control, cohort and intervention (i.e., PREDIMED) studies analysing the relation between olive oil and cardiovascular risk.
3. Moreover, in future studies it will be essential to distinguish between different types of olive oil (olive oil, virgin and extra virgin grades) when analysing its potential effects in cardiovascular disease prevention.

**Olive Oil and Cancer**

**General points:**

1. Total fat is not the key factor in human cancerogenesis, provided that there is a good balance between energy intake and energy expenditure.
2. The source and type of fat play a relevant role in human cancerogenesis.
3. Olive and fish oils are associated with a reduction of cancer risk, unlike oils rich in linoleic acid and possibly foods rich in saturated fat.

**Specific points:**

1. The anticancerogenic effect of both olive oil and its individual components, specifically oleic acid and non-fatty acid components, has been demonstrated experimentally in animal models and in human cell lines.
2. The potential mechanisms involved in cancer prevention after olive oil consumption are:
  - a. Modification of the gene response
  - b. Modulation of the oxidative inflammatory cascade
  - c. Induction of apoptosis
  - d. Cell differentiation and proliferation
  - e. Changes in the structure and function of cell membranes
3. Experimental evidence has been obtained on the beneficial effect of olive oil at different stages of carcinogenesis, including initiation, promotion and progression.

**Areas of relevant interest for future research:**

- (a) Epidemiology: a global analysis is recommended of a large set of data from Mediterranean countries on olive oil consumption and cancer risk.
- (b) Experimental research in the following fields:
  - b1. Specific effect of the different components of olive oil on cancer gene expression
  - b2. Role of olive oil components on angiogenesis
  - b3. Effects on metastatic cascade
- (c) Intervention studies in humans, looking particularly at:
  - High-risk populations
  - Average-risk populations, with particular regard to non-olive oil consumers
  - Cancer patients
- (d) Effect of different types of olive oil (extra virgin versus non-extra virgin olive oil).
- (e) Specific effect of olive oil versus eating patterns including olive oil.
- (f) Research in the areas of agriculture and production technology.
- (g) Olive oil and health education.

**Antioxidant Properties of Olive Oil**

**General points:**

1. There is evidence supporting the notion that the antioxidant content of olive oil contributes largely to its global health attributes. However, given the scarcity and controversial nature of the available randomised controlled studies, much more evidence is needed about the *in vivo* antioxidant activity of olive oil in humans.
2. One of the distinctive characteristics of the various types of olive oil is the diversity of their phenolic content, and the presence of other antioxidants in the case of virgin olive oil.
3. Olive oil phenolics are bio-available in humans.

**Specific points:**

1. The antioxidant content of olive oil can be estimated by measuring:
  - a. Total phenols
  - b. Orthodiphenolic phenols
  - c. Single phenolic compounds by chromatographic evaluation
  - d. Tocopherols
  - e. Total antioxidant activity of the phenolic extract

2. The antioxidant activity of olive oil *in vivo* can be assessed by using the following biomarkers:
  - a. Isoprostanes in urine and/or plasma
  - b. Circulating oxidised LDL
  - c. Uninduced conjugated dienes
  - d. Malondialdehyde
  - e. OH fatty acids
  - f. Lipid peroxides
  - g. 8-oxo-deoxyguanosine in lymphocytes and urine
  - h. Total antioxidant capacity (to be defined)
3. In postprandial studies virgin olive oil was more active than refined olive oil in reducing oxidative stress and endothelial dysfunction, which implies a biological activity linked to the minor components of olive oil.
4. Olive oil consumption has been shown to be inversely associated with both cognitive decline and overall survival in the ILSA study.

**Areas of relevant interest for future research:**

1. Implementation of carefully controlled studies of selected population groups to increase the solidity of the evidence linking olive oil antioxidant activity with optimal health and disease prevention.
2. Standardisation of current technologies for:
  - a. Antioxidant content of olive oil
  - b. Biomarkers of oxidation
3. Development of technology for antioxidant content optimisation.
4. Improvement of the knowledge about the relation between antioxidant content, flavour, shelf-life, and nutritional (health) aspects of olive oil.
5. Consumer education about the relationships between antioxidant content, oil stability, flavour and nutritional properties of the different types of commercial olive oils.

**Olive Oil and Aging**

1. Published evidence shows that virgin olive oil, in the context of the Mediterranean diet, may prevent age-related cognitive decline and dementia.
2. The current evidence suggests that a Mediterranean diet rich in monounsaturated oleic acid and antioxidants is associated with a significant increase in survival and overall longevity.

**Overall conclusions:**

1. In each one of the areas examined there is promising evidence supporting the beneficial health effects of olive oil, especially when consumed as part of a traditional Mediterranean diet.
2. In each of the areas examined there is an urgent need to obtain more solid epidemiological evidence from intervention studies examining disease endpoints.
3. In each of the areas examined there is a need to carry out more mechanistic studies to uncover the specific pathways regulated by the macro- and micro-nutrient constituents of olive oil. This is currently possible thanks to the dramatic advances of “-omic” technologies, including genomics, transcriptomics, proteomics, lipomics and metabolomics.
4. The use of new education technologies (via the Web) should be fostered in order to increase consumer knowledge and education (specially in non-olive oil producing countries) about the benefits of olive oil.
5. The IOC should serve as a catalyst for multinational/multidisciplinary research efforts by bringing together investigators interested in olive oil and health and providing the opportunity for exchanging ideas and knowledge and networking to generate funding from national and international organisations.