Letter to the Editor

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Oleocanthal in olive oil: Between myth and reality

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Olive oil is the staple fat of the Mediterranean Diet (MD) and several studies attribute many of the healthy advantages of this diet to its unique characteristics. Besides the very favorable fat composition, the other fundamental characteristic of this oil is the presence of a group of phenolic compounds belonging to the secoiridoid family.

A recent paper published by Beauchamp *et al*. [1] pointed out that one of the well-known phenolic compounds present in olive oil [2], the dialdehydic form of deacetoxy-ligstroside aglycone (called oleocanthal by the authors), which had been previously identified as one of the main substances responsible for the bitter taste of olive oil [3], is structurally related to the anti-inflammatory drug ibuprofen. The authors demonstrate that oleocanthal shares with ibuprofen the throat-irritating sensation and, most importantly, the ability to inhibit the cyclooxygenase enzymes COX-1 and COX-2. The authors estimate for oleocanthal a daily intake of 9 mg, corresponding to about 10% of the standard dose of ibuprofen, based on a daily consumption of 50 g olive oil containing 200 μg/ml (200 ppm) oleocanthal. With this evidence in mind, the authors suggested that the cardiovascular-protective effects attributed to the MD are in some way related to the regular intake of oleocanthal.

The conclusions made in this article triggered a lot of interest in the mass media of Mediterranean countries where olive oil has always been considered a natural anti-aging medicine, but it also raised severe doubts in the "olive oil" scientific community. Attributing the healthy effect of a diet to a single compound it is always hazardous, and this is particularly true for the oleocanthal present in olive oil as evidenced in the following quantitative considerations.

Oleocanthal represents about 10% of the total phenolic compounds and in extra virgin olive oil the concentration of phenolic compounds usually ranges between 100 and 300 mg/kg [2, 4]. Virgin olive oils from unripe olives of different varieties grown in a hot environment with a concentration up to 500 or even 1000 mg/kg have been described in the literature [5]; these oils are very bitter and pungent and therefore do not appeal to most consumers, hence they cannot be found on the market.

Furthermore, the actual daily intake of olive oil is nowadays far below 50 g per day [6]. All in all, an optimistic estimate of oleocanthal intake does not exceed 0.9 mg/day. Against this background, the "*in vivo*" anti-inflammatory effects of dietary oleocanthal cannot be as relevant as hypothesized by Beauchamp *et al*. [1].

A similar conclusion has been recently drawn about the prevention of *in vivo* LDL oxidation by phenolic compounds present in olive oil. The maximum concentration of olive oil phenols achievable in plasma cannot prevent LDL damage; in fact, *in vivo* human studies do not reveal any protective effects of olive oil phenols on LDL oxidisability [7].

In vitro studies on food compounds should always consider intestinal absorption and biotransformation. The knowledge available on the metabolic fate of olive oil phenolic compounds is still in its infancy. Absorption and bioavailability studies indicate that tyrosol and hydroxyl-tyrosol, namely the phenolic moiety of the olive oil phenol, can be retrieved in plasma and urine after olive oil consumption, whereas no data is available about the concentration of the various aglycons, including oleocanthal [7]. It is worth to notice that acid hydrolysis of oleocanthal would produce the elenolic acid dialdehyde, a compound even more similar to ibuprofen than oleocanthal itself.

There is no longer any doubt that certain foods, particularly olive oil, have the potential to modify physiological body functions, but it should be stressed that foods must be considered using a broader approach considering all the compounds present and not only the single one. In fact, it is very likely that the entire battery of structurally-related phenolic compounds present in olive oil enhances the anti-inflammatory action of oleocanthal. They may have additive but also synergic or complementary effects on other related physiological functions, such as LDL oxidation or blood pressure.

The ancient Chinese saying "food is my medicine" has become very popular. However, from the standpoint of molecular nutrition, food cannot be considered as a drug where the active compound is concentrated and formulated

in an optimal way to exert its activity. As it is not possible to complete a study on a drug without considering pharmacokinetic data, in the same way it can be misleading to draw conclusions on the biological properties of a single food component without considering the absorption and interactions with other food components. The latter point is particularly significant for a dialdehydic compound which is very reactive.

It is a commonly known that investigations on complex food mixtures do not always give as straightforward results as studies on single compounds, and the evidence accumulated to date on the biological properties of foods and their components demonstrates that food is not the algebraic sum of its components. A rigorous application of evidence-based medical rules to studies on food could increase the quality of science in this field and would avoid generating false myths among consumers about miraculous foods.

References

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