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REVIEW ARTICLE

Main Properties of Canola Oil Components: A Descriptive Review of Current Knowledge

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Abstract: Together with olive and soybean, canola is one of the most important and diffuse oilseed crops. Due to high oleic acid and antioxidant contents, canola oil shows positive effects on cholesterol, glycemic control, blood pressure and cancer. For these reasons, canola oil can be considered an important food-resource: future scientific research is expected to provide further evidence on adoption of canola oil as a standard dietary choice in healthy subjects as well as a therapeutic strategy in disease treatment.

Keywords: Antioxidants, Canola oil, Functional food, Human healthy, Oilseeds, Rapeseed.

INTRODUCTION

Oilseed is an important agricultural crop all over the world. Specifically, over the past 40 years, canola (*Brasica napus* cv canola), has become the third most important oilseed crops worldwide, and is the third largest source of vegetable oil in the world after soybean (*Glicine max*) and palm (*Elaiess* spp.) [1]. The various oilseed species in nature differ in their seed oil content, ranging from 20% for soybeans to over 40% for sunflowers (*Helianthus annuus*) and rapeseeds (*B. napus*) [2, 3].

Among the various kinds of oilseeds, olive oil *(Olea Europaea*), Canola oil and Soybean oil are recognized as the healthiest oils. Indeed, these oils have reported to benefit skin, heart health, diabetes, and even weight management [4]. Recently, several studies indicate that canola oil consumption positively influences biomarkers beyond blood lipids and in 2006 the U.S. Food and Drug Administration authorized a health claim for canola oil: *"Canola oil (19 grams – about 1 ½ tablespoons per day) may reduce the risk of coronary heart disease due to its unsaturated fat content, according to supportive but not conclusive research. Canola oil should replace a similar amount of saturated fat in the diet without increasing calories"* [5]. The present paper aims at giving a general overview of canola oil and its health benefits, through a review of the available literature.

Canola Origin

Rapeseed is a bright yellow flower of the family of the Brassicaceae, grown in European Union, Unites States, Canada, Australia, China and India. It is an important oil crop species and its cultivation has significantly increased over recent years. The origin of *B. napus* are not well known: probably it is the result of a natural interspecific hybridization between two other species of Brassicaceae, the *B. oleracea* and the *B. rapa* [6]. *Brassica* genus is an ancient plant, first historical findings date back to 2000 and 1500 BC from some Sanskrit manuscripts that explicitly refer to oilseed rape

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[7]. Rapeseed flowers were popular also in ancient Rome and Gallia [8], in Germany and Switzerland, used as decorative element of graves and buildings [9]. In Europe, domestication of the plant occurred in the early middle age and commercial plantings of rapeseed were recorded before 16th century in the Low Countries. After the Second World War, consequently to the improvement of oil and meal quality, rapeseed production has increased dramatically both in Europe and Canada. Together with China and India, these two countries are now the top producers: Canada is currently considered the largest single producer of rapeseed particularly the cultivar canola, with nearly 5 million hectares grown annually [10].

The rapeseed oil is used for industrial and commercial purposes (for the production of soaps, candles, inks, lubricants and biofuels), however it is not used for human and animal consumption, due to the high content of erucic acid and glucosinolates. Glucosinolates are a goup of sulphur-containing glucoside present in brassica plants [11]: some of their degradation products have been related to negative health effect due to goitrogenic activity, althought evidence on humans still remain uncertain [12] Erucic acid is a fatty acid unsuited for consumption [13]: large amounts of this acid are toxic for humans and associated with fibrotic heart lesions. It's commonly known that in Spain, in 1981, the misuse of rapeseed oil has caused the diffusion of a multi-systemic disease, called Toxic Oil Syndrome (TOS) [12]. The consumption of refined rapeseed oil, rich of glucosinalates, has been fraudulently marketed for human consumption after being denatured with aniline, a toxic compound responsible of the Spanish epidemic [14]. TOS was characterized by the presence of important functional and psychosocial disabilities limiting performance of daily activities and social role, like peripheral neuropathy, scleroderma, hepatopaty, pulmonary hypertension, involuntary muscular activity and articular deformities [15]. Although the relationship between rapeseed oil consumption and TOS incidence was based on strong epidemiological evidence [16], till today the effect has not been replicated yet in experimental trials, and none of this studies performed with toxic-oil-specific components, such as acid aniline, have provided evidence that these markers are involved in the pathogenesis of TOS [16].

In order to avoid the toxic effect of oil, rapeseed plant breeders used conventional breeding techniques to remove large part of erucic acid and glucosinolates from flowers. To describe a crop with low level of both compounds, in Canada was coined the term canola [13] (an abbreviation of "CANadian Oilseed Low Acid) in 1979 [17]. Canola name is currently used to indicate three species of the genus *Brassica* that produce oil with low level of erucic acid (less than 2%), and less than 30 μmol/g meal of total glucosinolates: *Brassica rapa*, *Brassica napus* and *Brassica juncea* [18]. The implementation of agriculture techniques able to reduce the undesirable substances and improve the functional properties has been a fundamental step to introduce this oil for human and animal consumption purposes: nowadays the canola oil can be used in diet, since it does not represent a danger, but an alternative source of healthy food.

Canola oil is extracted either through seeds cold pressing or through solvent methods [19]. Once extracted, the oil is employed mainly for culinary needs, as cooking oil, in shortening and margarine and to make salad dressing. This oil is used in cooking for frying because it has a neutral flavor and is resistant at higher temperatures better than many other oils, without smoking and burning [20].

HEALTHY PROPRIETIES OF CANOLA OIL

The Effect on Cardiovascular System

Lifestyle and dietary modifications are strongly recommended as efficient and early interventional approaches to reduce risk factors of coronary heart disease (CHD). For years, researchers examined role of dietary fatty acids in the modulation of serum cholesterol, as well as their relation with heart diseases [21, 22]. Various clinical studies showed that high intakes of specific dietary saturated fatty acids (SFA) and low intakes of monounsaturated and polyunsaturated fatty acids (respectively MUFA and PUFA), are associated with high serum cholesterol and high risk of CHD [21, 23, 24]. Thus, dietary interventions are considered as a part of a comprehensive strategy to lower the incidence and severity of CHD and to promote protection of cardiovascular structure [25]. Canola oil contains moderate level of PUFA (32%) and high levels of oleic acid (61%), a monounsaturated fatty acid. Oleic acid showed to reduce low-density lipoproteins (LDL), without affecting high-density lipoproteins (HDL) [26]: indeed, while high levels of LDL are associated to an increased risk in cardiovascular disease [27] high level of HDLs have opposite effects, protecting subject from atherosclerosis [28].

Among polyunsaturated fatty acids, Canola oil contains a high level (21%) of linoleic acid (ω-6) and an appreciable amount (11%) of α-linolenic acid (ω-3) [29]. Specifically α-linolenic acid is effective in serum triglyceride and platelet aggregation reduction, increasing blood clotting time. These anti-blood clotting effects are very important for the

reduction of CHD [30, 31]. The healthy effect of canola oil on cholesterol is recognized by many health organizations, including the American Dietetic Association [32], American Heart Association [33] and the U.S. Food and Drug Administration [5].

Antioxidant Proprieties

Several studies show that canola oil contains different antioxidant substances [34 - 36]: vitamin E [37], with important variability in content and composition among rapeseed varieties [38], carotenoids and phenolic compounds [39, 40]. Vitamin E is one of the most important natural anti-oxidant and radical scavenger, able to maintain the cellular integrity and promote the prevention and treatment of cancer, atherosclerosis and neurological diseases [41 - 43]. Carotenoid accumulation in seeds reaches the highest levels in 35-40 days after anthesis, the period in which a flower is fully open and functional [44]. The most abundant phenolic compound in canola oil is 2,6-Dymethoxoy-4-vinylphenol, known as Canolol, considered the most active component in the oil [45]. Canolol is able to scavenger not only peroxil radicals but also peroxynitrite, a high potent oxidizing and nitrating agent forming during the reaction of superoxide radicals with nitric oxide [45]. Canolol is almost completely lost during oil refining, especially during bleaching and deodorization: for this reason some techniques were developed to preserve its antioxidant activity [46].

Antioxidant Components Give Canola Oil an Important Role in Prevention and Treatment of Breast Cancer [47] and colon cancer [48]. Indeed, oil's action seems to be able to modulate growth and death of tumor cells, acting on oxidation processes. Canola oil contributes to protecting cells from oxidative damage caused by peroxide and free radicals by reducing level of lipid peroxidation [49], and thus positively acting on development of degenerative status such as cancer, atherosclerosis and neurological diseases.

Action on Blood Pressure, Glycemic Control and Inflammatory System

Canola oil seems to show anti-hypertensive activity. Recent animals trials confirm this specific propriety, proving that canola oil has a better effect on pressure, compared to other vegetables oils [50]. Moreover, it has been demonstrated that the supplementation of canola oil, rich of MUFA and α-linolenic acid (ALA), improve glycemic control in diabetic patients with high systolic blood pressure [51].

Canola oil is important also for its anti-inflammatory and anti-mutagenic activity. The first propriety has been reported by a Finnish study in which two different rapeseed compounds, vinylsyringol and sinapic acid, inhibit the formation of nitric oxide and prostaglandin E2 [52]. Other studies demonstrates the anti-mutagenic action of canola oil [53, 54], that can be used as additive treatment in cancer therapy due to its protective effects against oxidative reactions.

CONCLUSION

Nowadays canola oil can be considered as an important functional food, due to its role in prevention and management of many disorders. Future scientific research is expected to provide further evidence on adoption of canola oil as a standard dietary choice in healthy subjects as well as a therapeutic strategy in disease treatment.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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