

Evidence of health benefits of canola oil

By Lin Lin, Hanja Allemekinders, Angela Dansby, Lisa Campbell, Shaunda Durance-Tod, Alvin Berger and Peter JH Jones

Over the past 40 years, canola has become one of the most important oilseeds crops worldwide. Today, canola oil is the third-largest vegetable oil by volume after palm and soya bean oil. The worldwide production of canola oil in 2010/11 was 38 million metric tons, with Europe accounting for 63% and Canada accounting for 31% globally.

In the United States, canola oil is one of the most widely consumed oils, second only to soya bean oil. Canola oil is characterised by the following: low level (7%) of saturated fatty acids (SFAs); substantial amounts of monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs), including 61% oleic acid, 21% linoleic acid, and 11% alpha-linolenic acid (ALA); plant sterols (0,53 to 0,97%); and tocopherols (700 to 1 200ppm) – all of which have data indicating they are cardioprotective substances.

Recently, growing numbers of studies indicate that biomarkers beyond blood lipids are beneficially influenced by canola oil consumption. The objective of this review was to conduct a literature assessment to examine the health benefits of intact canola oil, rather than focus on the effects of individual components in the oil. This approach can be considered more practical since consumers make choices between intact cooking oils for consumption.

> Diets based on canola oil showed positive effects on TC levels regardless of the type of canola oil used compared to a typical Western diet.

The specific aim of this review was to describe the effects of canola oil consumption on, among others, cholesterol, inflammation, insulin sensitivity, energy metabolism and cancer.

Cholesterol

SFAs are found in animal fat and dairy products as well as certain types of vegetable oils, including coconut and palm oils. Typical Western diets are high in SFAs. A high amount of dietary SFA may increase total cholesterol (TC) and low-density lipoprotein (LDL-C) levels, thus increasing the risk of developing cardiovascular disease. Efforts to substitute SFAs have typically relied on replacement of animal fat and dairy products with liquid vegetable oils high in MUFAs and PUFAs.

In terms of total cholesterol levels, five studies compared canola oil-based diets with typical Western diets, providing evidence that canola oil can reduce TC levels by an average of 12,2%. Diets based on canola oil showed positive effects on TC levels regardless of the type of canola oil used compared to a typical Western diet.

Seven studies compared canola oil-based diets with those high in SFAs. The high-SFA diets in these studies contained >12% energy from SFAs and >30% energy from total fat, mainly in the form of butter, margarine, mayonnaise, and other high-SFA food. Five of the seven studies examined the effects of margarines or mayonnaises made with canola oil on TC levels and all showed a lowering of TC levels, ranging from 3,3 to 21,7%, compared with a high-SFA-treated group.

Palomäki *et al.* and Valsta *et al.* fed their subjects diets containing canola oil or a high-SFA alternative rather than incorporating the oil into food products;

their results demonstrated significant lowering of TC levels with the canola oil, at 8,3 and 15,5%, respectively, compared with the high-SFA alternative. Results from all seven studies consistently showed that replacing higher SFA diets with canola oil, decreased TC levels.

Baudet and Jacotot, Iggman *et al.* and Karvonen *et al.* compared dietary canola oil with various high-SFA dairy products. Substituting canola oil for dairy fat caused TC levels to decrease by 18,4, 16,1 and 5,1%, respectively, in these three studies. Current food technology allows substitution of SFA with canola oil in dairy manufacturing, which may offer new options for regulating blood cholesterol levels and, thereby, reduce the risk of cardiovascular disease.

SFAs are not only found in animal fat but are also derived from vegetable oils such as coconut and palm oils. Some commercial food manufacturers have selected high-SFA vegetable oils as alternatives to animal fat because of taste. When comparing canola oil-based diets to palm oil-based diets, Sundram *et al.* found a 2,2% reduction in TC and Vega-López *et al.* observed a 12,5% decrease in TC levels with the canola oil-based diets.

Overall, clinical studies have shown that compared with high-SFA or typical Western diets, canola oil-based diets can reduce TC concentrations in healthy or hypercholesterolemic individuals.

Inflammation

Epidemiological studies in Greenland Inuit cohorts have shown that a lower incidence of coronary heart disease (CHD) mortality is not only associated with lower plasma TC and triacylglycerol (TAG) levels, but also with decreased platelet aggregation in vitro as well as lower thromboxane A2 (TXA2) synthesis rates.

TXA2 is a prothrombotic agent contributing to platelet activation and aggregation and is the principal metabolite of arachidonic acid, an omega-6 fatty acid. In contrast, the omega-3 fatty acid eicosapentaenoic acid can be converted to TXA3, having lesser platelet aggregatory activity relative to TXA2. Several studies have investigated the effects of a canola oil-based diet on biomarkers of antioxidant status, platelet aggregation, and inflammation in the context of CHD risk.

Kwon *et al.* examined the effects of diets high in MUFA (canola oil) or PUFA (safflower oil) on platelet aggregation and formation of thromboxane B2 (TXB2), the prothrombotic stable metabolite of TXA2. After three weeks, the canola and safflower oil groups both showed decreases in platelet aggregation compared to the high-SFA baseline diet, but values returned to baseline levels at week eight. No significant differences in TXB2 concentrations were observed between the dietary intervention groups.

> In the United States, canola oil is one of the most widely consumed oils, second only to soya bean oil.

Taken together, canola and safflower oil-based diets both resulted in temporarily reduced platelet aggregation compared with an SFA-based diet. However, the canola oil-based diet resulted in longer beneficial effects on platelet function than the safflower oil-based diet.

Antioxidants

Södergren *et al.* examined the effects of a canola oil-based diet compared to an SFA-based diet on biomarkers of antioxidative capacity. Levels of g-tocopherol were higher following the canola oil-based diet compared to the SFA-based diet. Because of its antioxidant activity, the increased levels of g-tocopherol may have protected the PUFA in the canola oil diet from oxidation.

No differences in a-tocopherol were observed between the two diets, resulting in a decreased a- to g-tocopherol ratio with the canola oil-based diet compared to the SFA-based diet. The relevance of this finding is demonstrated by other studies that associated low g-tocopherol concentrations and a high a- to g-tocopherol ratio with CHD incidence.

In summary, canola oil may potentially promote immune and cardiovascular health through its antithrombic and antioxidative effects.

Energy metabolism

Not all dietary fats undergo equivalent partitioning for energy expenditure, and some may exhibit satiety promoting actions. To help individuals maintain normal bodyweight and prevent obesity, studies have examined food intake, satiety, bodyweight, body mass index, and body composition following consumption of different types of oils.

Furthermore, dietary fatty acid composition plays an important role in metabolism and gene expression. Some studies have explored the possible actions of oleic acid-rich oils, such as olive and canola oils, given older data suggesting preferential partitioning of oleic acid for oxidation versus retention in body storage compartments.

A few studies examined the direct actions of canola oil-based diets on human energy metabolism. For example, Maljaars *et al.* analysed the satiating effect of fat and its physiochemical properties in a double-blind, randomised crossover study. In this study, fat emulsions consisting of 6g of shea, canola oil, or safflower oil were each provided to 15 healthy subjects. After four days, the canola and safflower oils significantly increased fullness and reduced hunger compared with the saline control treatment, but no effects on food intake were observed.

Gut peptides involved in the regulation of satiety and food intake were also analysed in this study. Cholecystokinin secretion increased with canola oil feeding compared with the control, but no dietary effect was observed on peptide YY secretion. This study concluded that canola oil can increase cholecystokinin levels, which may, in turn, mediate the satiating effects in the ileum, but not in peptide YY.

Insulin sensitivity

Evidence has shown that SFA intake is linked with insulin resistance, obesity, and metabolic syndrome. In a recent review by Gillingham *et al.* on the health benefits of MUFAs, it was concluded that MUFAs are capable of favourably modulating insulin sensitivity and glycaemic control when substituted for SFAs.

Many dietary intervention studies have tested the effects that substitution of SFAs with MUFAs or PUFAs has on insulin sensitivity. However, many other factors beyond dietary fatty acid composition may influence glucose tolerance and insulin sensitivity. In this arena, the focus has been on the clinical outcomes of canola oil-based diets on insulin sensitivity and glucose tolerance compared to diets higher in SFAs and unsaturated fatty acids.

Uusitupa *et al.* reported lower levels of glucose and steeper glucose disappearance rates in participants who consumed a canola oil-based diet compared with a high-SFA diet after an intravenous glucose tolerance test. Södergren *et al.* reported that consumption of a canola oil-based diet lowered fasting plasma glucose levels compared with an SFA diet while fasting insulin levels did not differ between the two diets. Results from Gustafsson *et al.* showed that fasting blood glucose levels decreased 6% following a canola oil-based diet compared to baseline values (containing SFA >15%). No significant differences were found between canola oil and sunflower oil diets.

Compared with partially hydrogenated soya bean oil, canola oil showed a lower insulin concentration and lower homeostasis model assessment ratio. However, there was no difference between these two oils with regard to their effects on plasma glucose concentrations, which suggests canola oil may have a potential effect on insulin sensitivity. In general, canola oil-based diets show positive results in modulating glucose and insulin levels compared with SFA-based diets.

Cancer

The association between lipid intake and various cancers has been understudied, particularly in humans. While no human clinical trials specific to canola oil and cancer have been performed to date, in vitro and in vivo animal data exist and are examined here.

Jiang *et al.* pointed out that omega-3 fatty acids are toxic to tumour cells, but omega-6 fatty acids, such as linolenic acid, enhance carcinogenesis and tumour cell growth. Nevertheless, in a systematic review by Hooper *et al.*, no consistent effects of omega-3 fatty acids on the incidence of cancer were identified.

Over the past few decades, investigations of the protective effects of dietary fat quality, particularly omega-3 fats, on common cancers, including breast, colon, and prostate cancers, have not been exclusively focused on fish oil. Plant-based oils such as canola oil, which is a good source (11%) of ALA, have also been examined for their potential to modulate cancer cell growth and death. Protective effects of canola oil compared with corn oil against breast and colon cancers have been reported in various cell and animal studies; however, more research is required to provide definitive direction in this area.

Certain human studies have investigated the clinical effects of canola oil on carcinogenic substances. Fang *et al.* found lower levels of DNA adducts of malonaldehyde in participants consuming a canola oil-based diet compared with subjects consuming a sunflower oil-based diet. This result was not surprising, as sunflower oil would be expected to be high in PUFAs, resulting in enhanced peroxidation of PUFAs compared with the rate of peroxidation in the canola oil group.

In a study by Nair *et al.*, however, DNA adducts, formed by carcinogenic agents, were not decreased in males but were, on average, 44 times lower in females on a canola oil diet compared to a soya bean oil diet.

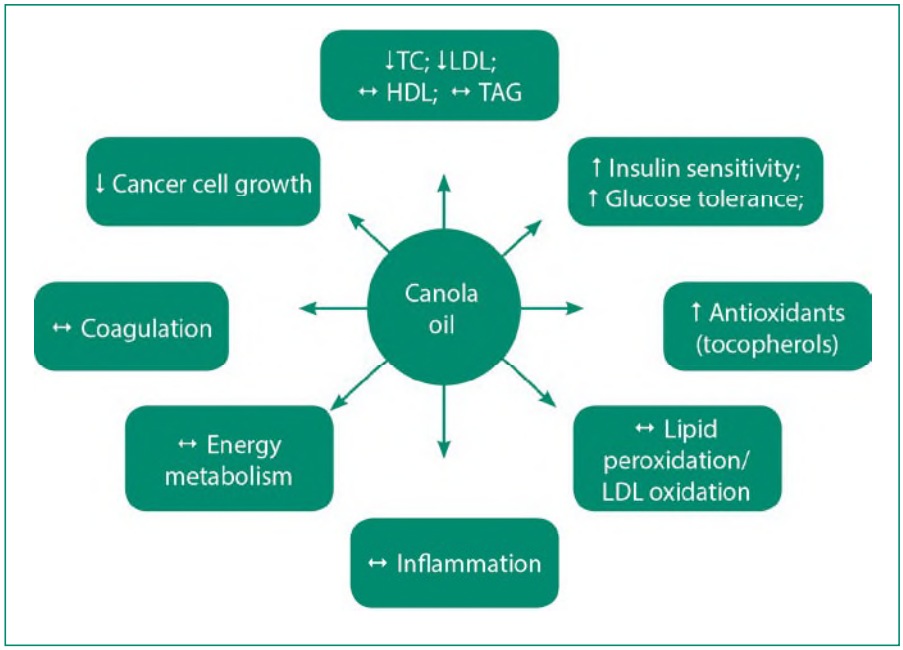
To conclude, studies exploring linkages between canola oil consumption and cancer risk modification remain equivocal.

Findings

Results of this review regarding the biological efficacy of health benefits from canola oil have demonstrated both positive and neutral actions, as illustrated in *Figure 1*.

Evidence shows several potential health benefits of canola oil consumption. Canola oil can now be regarded as one of the healthiest edible vegetable oils in terms of its biological functions and its ability to aid in reducing disease-related risk factors and improving health. Current research is expected to provide more complete evidence to support the health-promoting effects of canola oil when consumed at levels consistent with dietary guidelines.

Figure 1: Effect of canola oil on health-related risk factors.



This article has been shortened for publication in *Oilseeds Focus*. To read the full article, visit *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3746113/*.