



Composition corn oil determinate for spectroscopy IR

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Abstract

Corn oil is 100% fat, with no protein or carbohydrates. One tablespoon (15 ml) of corn oil contains: calories: 122; fat: 14 g; vitamin E: 13% of the recommended daily intake. It contains absorption bands between 4000 and 450cm⁻¹ and were determined with a Perkin Elmer Fourier spectrometer. Corn oil contains the following functional groups: C-H, C=C, -CH=CH₂.

Keywords: Chemical composition, corn oil, IR spectroscopy

Introduction

Corn oil is a refined vegetable oil widely used in cooking and especially frying. Corn oil also has many other uses and is commonly used for industrial purposes or as an ingredient in cosmetic products.

Corn must go through a complex refining process to produce corn oil. This process gives corn oil many unique characteristics, although not all of them are positive.

Corn oil is 100% fat, with no protein or carbohydrates. One tablespoon (15 ml) of corn oil contains: Calories: 122; Fat: 14 g; Vitamin E: 13% of the DV.

During the process of extracting corn oil from corn, many vitamins and minerals are lost. However, the oil does have a fairly high amount of vitamin E. Vitamin E is a fat-soluble nutrient that acts as an anti-inflammatory antioxidant in the body.

Antioxidants are compounds that neutralize molecules called free radicals, which can increase your risk of conditions like heart disease, type 2 diabetes, and some cancers when they become too high.

Additionally, corn oil contains about 30-60% linoleic acid, a type of omega-6 polyunsaturated fat. Polyunsaturated fats include omega-6 and omega-3 fats. The latter are associated with reduced inflammation and better health when present in the body in a ratio of about 4:1 omega-6 to omega-3.

However, many people's diets contain too many inflammatory omega-6 fats and not enough anti-inflammatory omega-3 fats^[1-5].

Corn oil has an omega-6 to omega-3 ratio of 46:1, which can contribute to this imbalance. Corn oil has a variety of uses in cooking and beyond. Corn oil is used as a cleaning agent and industrial lubricant, as well as to produce fuel for gasoline and diesel engines.

In addition, corn oil is included in many cosmetics, liquid soaps, shampoos, paints and inks. It has also been used in the production of certain insecticides and in the manufacture of biodiesel (a liquid synthetic biofuel).

Moreover, corn oil is the most well-known frying oil. It has a very high smoke point (the temperature at which the oil begins to burn) of about 232 °C, making it ideal for frying foods, making them crispy without burning them.

Corn oil is widely available, which makes it a very common choice in cooks. It can be purchased at almost any grocery store and used in many ways, such as for: sautéing and

frying; salad dressings and marinades; cakes, breads and other baked goods.

Corn oil must go through an extensive refining process to be extracted from corn. With a fat content of only about 1-4%, corn is not a naturally oily food. Therefore, it must go through an extensive process to be able to extract the oil from corn. The corn seeds (kernels) must first be mechanically pressed to separate the oil. The oil then goes through a series of chemical processes to remove impurities, as well as undesirable odors and tastes.

The following processes that are involved in the production of corn oil remove many vitamins and minerals and can even introduce harmful substances

- **Hexane extraction:** Corn is washed with a solution containing a chemical called hexane that causes it to release oil. Researchers have shown that hexane has a negative impact on the nervous system in humans and animals.
- **Deodorization:** Unwanted odors and tastes are removed from the oil, along with some healthy compounds. Before this step, the odor and taste of corn oil would make it unsuitable for cooking.
- **Winterization:** Waxes and saturated fats are removed from the oil so that it remains liquid at low temperatures. Without winterization, many vegetable oils would solidify at low temperatures.

Corn oil appears to have beneficial effects on health, as demonstrated by some studies.

Corn oil contains compounds that may promote heart health, such as phytosterols, vitamin E, and linoleic acid.

Corn oil is full of phytosterols, which are plant-based compounds with a similar structure to the cholesterol found in animals. Phytosterols are potentially anti-inflammatory, and a diet rich in anti-inflammatory foods may reduce the risk of certain conditions, such as heart disease, type 2 diabetes, and some types of cancer^[6-12].

Corn oil is high in phytosterols compared to other cooking oils, such as peanut, olive, and canola oils. Corn oil is particularly rich in the phytosterol beta-sitosterol.

Test-tube studies have found that beta-sitosterol may have anti-tumor properties. In one study, beta-sitosterol was able

to significantly slow the growth of lung cancer cells, without having any effect on healthy lung cells.

However, more human research is needed to understand the potential anti-cancer properties of beta-sitosterol.

Additionally, phytosterols are known to help block the body from absorbing cholesterol. As such, they may help lower high cholesterol levels, which is a risk factor for heart disease.

Since corn oil contains heart-healthy compounds like vitamin E, linoleic acid, and phytosterols, it may reduce your risk of heart disease.

Vitamin E is a powerful antioxidant, so a diet rich in this nutrient can prevent oxidative damage to the heart and blood vessels caused by excess free radicals.

Some studies also show that corn oil itself helps reduce cholesterol, especially bad cholesterol (LDL), likely due to its phytosterol content.

Corn oil has some significant drawbacks that may outweigh its potential health benefits.

Corn oil is high in linoleic acid, an Omega-6 fat that can be harmful if consumed in excess. According to most research, the human body needs to maintain an Omega-6 to Omega-3 ratio of about 4:1 for optimal health.

Most people consume these fats in a ratio of about 20:1, eating far more Omega-6 fats than Omega-3.

This imbalance has been linked to conditions such as obesity, impaired brain function, depression, and heart disease.

A proper balance of these fats is important because Omega-6 fats tend to be pro-inflammatory, especially when there aren't enough anti-inflammatory Omega-3 fats present.

Limiting corn oil and other foods high in Omega-6 fats while increasing your intake of foods high in Omega-3 fats, such as fatty fish and chia seeds, can help reduce inflammation and promote overall health.

Corn oil can be made from genetically modified (GMO) corn to be resistant to insects and certain herbicides, such as glyphosate.

Many people are concerned about the effects of glyphosate accumulating in the body from eating glyphosate-resistant GMO foods that have been treated with high amounts of the herbicide.

Additionally, there is speculation that genetically modified foods and glyphosate may contribute to the rapid rise in food allergies and intolerance rates. While several short-term studies have concluded that genetically modified foods are safe, long-term research is lacking.

An animal study compared the effects of introducing corn oil versus extra virgin olive oil into the diet, even immediately after weaning, and whether there is any link with the development of breast cancer in adulthood.

The researchers found that females in the study with a diet rich in corn oil primarily increased their weight and body mass. The extra virgin olive oil diet did not change these parameters and increased the hepatic expression of an enzyme that even suggests a decrease in the intake/expenditure balance.

Both diets differentially altered the gene expression profile of the mammary gland, even after a short dietary intervention. Nutritional factors that influence growth, maturation, and adiposity may have an impact on

susceptibility to breast cancer transformation. In fact, obesity and early menarche are well-known risk factors for human breast cancer.

Given that both high-fat diets have an excess of lipid content, these data highlight that not only caloric intake but also the type of lipid consumed are important factors in controlling body weight. The results obtained suggest that these two types of lipids may have different effects on the energy intake/expenditure balance and are also consistent with other authors reporting that olive oil produces a lower increase in body weight than saturated fat and corn oil.

Corn oil downregulated the expression of genes related to the immune system and apoptosis, while olive oil altered the expression of metabolism genes. Further analyses suggested an increase in proliferation and lower apoptosis in mammary glands by the effect of the high-fat diet, which may be one of the mechanisms of its stimulatory effect on carcinogenesis.

Dietary exposure also induced a specific gene expression profile in the mammary glands, suggesting a stronger impact by the effect of the corn oil-rich diet than by the extra virgin olive oil diet. The effect of the corn oil-rich diet is compatible with an increase in the proliferation/apoptosis balance in the mammary gland, which could be one of the mechanisms of the increased susceptibility to malignant transformation and the promotion of the microenvironment in this tissue [13-17].

Taken together, the findings highlight the importance of dietary habits, especially (but not exclusively) from an early age, on future breast cancer risk.

Corn oil is a highly refined product. It must go through an extensive process to be extracted from corn and made edible.

This process makes corn oil more likely to oxidize, which means that at a molecular level, it begins to lose electrons, becoming unstable. High levels of oxidized compounds in your body can increase your risk of certain diseases.

In fact, the beta-sitosterol in corn oil oxidizes as it is heated for long periods of time, such as in a deep fryer. However, the antioxidant vitamin E helps slow this process.

Heating corn oil also produces the antinutrient acrylamide, a highly reactive compound that has been linked to problems with nerve, hormone, and muscle function.

Acrylamide has been classified as a probable carcinogen by the International Agency for Research on Cancer (IARC).

So, since corn oil is not the healthiest choice for cooking, you can opt for healthier alternatives, such as olive oil.

Materials and methods

Materials

Edible corn oil are purchased in local commerce.

Sample preparation for FTIR analysis

Perkin Elmer Fourier transform infrared spectrometer with deuterated triglycin sulphate (DTGS) as a detector is used for the analysis. The liquid sample is placed between two KBr pellets with the help of capillary tube. Each pellet is made of 0.2mm thickness and it is placed in the path of the sample beam. The spectra are recorded from 4000 to 450cm⁻¹, the number of scans being 256 at a resolution of 4cm⁻¹. Scan speed is 0.20cm/s.



Fig 1: Perkin Elmer Fourier transform infrared spectrometer

Results and discussions

Figures 2 and 3 show the IR spectra of unheated and heated corn oil.

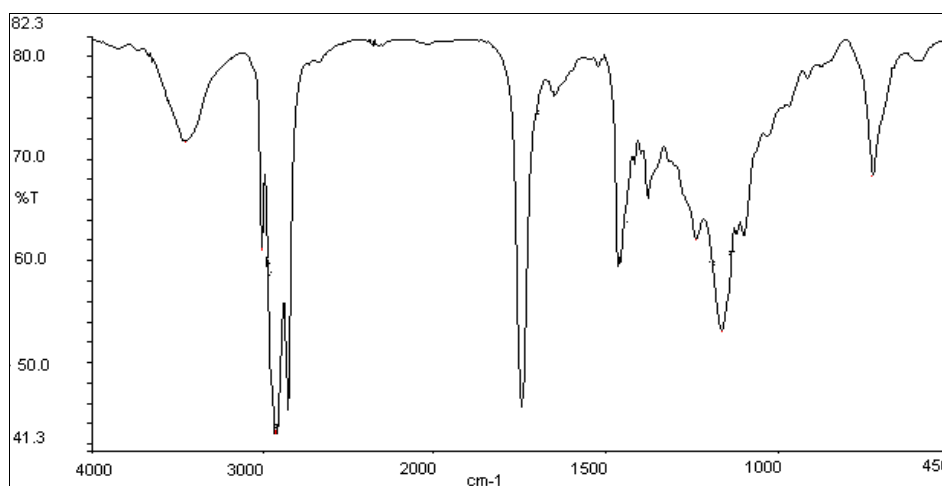


Fig 2: FTIR spectra of corn oil (unheated)

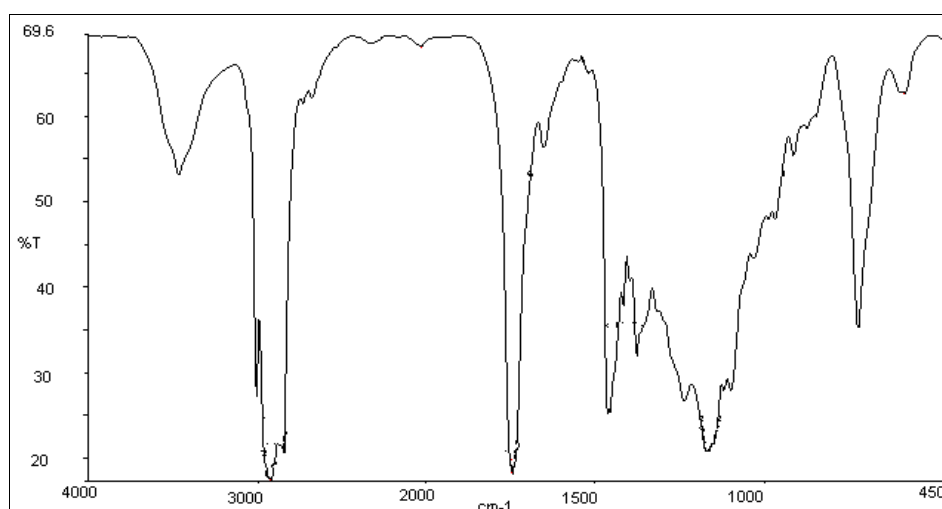


Fig 3: FTIR spectra of corn oil (heated)

Fig 2 shows the FTIR spectra of unheated corn oil. To study the thermal degradation the oil is heated for one hour and the process is repeated 5 times and it is shown in fig.3. From the figures it is observed that the transmission at 3008,

2924, 2854, 1463, 1378, 1237, 1163, 1099, 722 cm^{-1} exist. The presence of the same wavelength in both cases reveal that most of the compounds can maintain stability due to the presence of antioxidants Also it is observed from the fig 5

that the transmission 1417 cm^{-1} , 1746 cm^{-1} , 3471 cm^{-1} are changed due to partial thermal degradation of oil. The presence of transmission 1417 cm^{-1} in Fig 3 may be due to rocking vibrations of $-\text{CH}$ bonds of *cis* disubstituted olefins [9]. Also the broadening of transmission at 1746 cm^{-1} in fig.3 is due to the production of saturated aldehydes functional groups or other secondary oxidation products that cause a transmission at 1728 cm^{-1} that overlaps with the stretching vibration at 1746 cm^{-1} of the ester carbonyl functional group of the triglycerides. This results correlate with the earlier reference [9]. When new carbonyls are formed from initial aldehydes and ketones compounds, the maximum absorbance is in the region between 1700 and 1726 cm^{-1} resulting in a broadening of carbonyl region [9]. The 1651.57 cm^{-1} band show $\text{C}=\text{C}$ stretching vibration of *cis*-olefins [10]. It is also observed that the valley between 2925 and 2854 cm^{-1} has found to be deepened during heating. This may be due to the change in the characteristic of oregano [11]. Shift in transmission from 3448 cm^{-1} to 3471 cm^{-1} has been observed. Hamed and Mousa A.Allam (2006) have mentioned that hydroperoxide band of the sample without antioxidant is much higher than that of sample containing antioxidants. In our present study, the hydroperoxide band showed increased transmission while heating. This possibly will be due to the loss of various antioxidants during heating. The transmission 915 cm^{-1} has been formed due to $-\text{CH}=\text{CH}_2$ (in unsaturated fatty acids) out of plane bending [10]. Unsaturated bonds are reactive and new atoms attached without disrupting the existing skeleton of the hydrocarbon, though a large majority of lipids are fatty acid tri-esters of glycerol.

Conclusions

The IR spectra of unheated and heated corn oil contain absorption bands between 4000 and 450 cm^{-1} and were determined with a Perkin Elmer Fourier spectrometer and have the following functional groups: C-H , $\text{C}=\text{C}$, $-\text{CH}=\text{CH}_2$.

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