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Composition determined by IR spectroscopy of soybean oil

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Abstract
Soybean oil is obtained from soybeans, which contain 16-19% oil, by the extraction process. Soybean oil is rich in polyunsaturated fatty acids and low in saturated fatty acids.
The composition of soybean oil was determined with the NICOLET iS50 spectrometer and contains absorption bands between the wavelengths 3009 and 457cm^{-1}. Soybean oil contains the following functional groups: C=H, C-H, C=O, C-O, C-N, CH2, CH_3, COO, PO_2, CO-O-C, C-O, O-C-O.

Keywords: Chemical composition, soybean oil, IR spectroscopy

Introduction

Soybean oil is obtained from soybeans, which contain 16-19% oil, through the extraction process. Soybean oil is rich in polyunsaturated fatty acids and low in saturated fatty acids. It can be consumed both raw and cooked, as it has a high burning point (232°C). It is light yellow in color, has a neutral flavor and moderate viscosity. Soybean oil contains approximately 60% polyunsaturated fats, 20% monounsaturated fats and 15% saturated fats. 100 g of soybean oil provides a caloric intake of 884 kcal to the body and contains: 57.74 g polyunsaturated fatty acids; 22.78 g monounsaturated fatty acids; 15.65 g saturated fatty acids; 0.53 g trans fatty acids; 8.18 mg vitamin E; 183.9 µg vitamin K; 0.05 mg iron; 0.01 mg zinc [1-5].

Soybean oil can treat itching and dry skin The effectiveness of soybean oil on itching and dry skin was demonstrated in a clinical study conducted on more than 3,500 patients. Of these, 86.4% were diagnosed with atopic eczema at the beginning of the study. The treatment involved the use of a bath oil containing 82.95% soybean oil and 15% medicinal substance with a local anesthetic role, for 42 days.

Soybean oil has an emollient role on dry skin and helps restore the outer layer of the skin. The active substance used has an anesthetic role on the area affected by eczema and itching. The use of the oil was contraindicated for people allergic to soy and soy-based compounds, as well as people with psoriasis. Overall positive results were observed in 89.4% of participants.

Due to its vitamin E content, soybean oil is considered a powerful anti-oxidant, helping to maintain the integrity of cell membranes and providing skin protection against free radicals [6-12].

Soybean oil is the vegetable oil with the highest vitamin K content (183.9 µg). This helps in the synthesis of essential amino acids and in the regulation of blood clotting factors. Vitamin K also helps in the healthy development of bones.

A diet containing partially hydrogenated or non-hydrogenated soybean oil as a source of fat has a beneficial effect on blood lipid levels, by lowering LDL-cholesterol ("bad" cholesterol). The favorable effects were observed in a study conducted on 31 men, for 21 days.

The results were compared with those due to the consumption of butter and fish oil, with each of the participants following all three diets successively. The benefits of soybean oil compared to other types of fats consumed by participants are due to its low content of saturated fatty acids and the lack of cholesterol in its composition.

Due to its phytosterol content, soybean oil inhibits the absorption of cholesterol, thus improving the body's lipid profile. Thus, it can help reduce the risk of developing cardiovascular diseases.

Emulsions are pharmaceutical preparations made up of components that do not mix with each other (usually oil and another substance) and allow the incorporation of drugs. They are used in the preparation of vaccines, for some blood substitutes and intracorporeal drug delivery systems - with the role of directing the drug exactly to the target site and its controlled release.

Such emulsions, which can be administered orally or by injection, use soybean oil to incorporate the drug substance. It is chosen over other oils because it is considered to be associated with the fewest adverse reactions.

Studies are underway regarding the possibility of injecting such solutions intratumorally, to facilitate healing.

Soybeans and soy products are part of the class of food substances that can be an allergic factor for some people. Allergy to soybean oil can manifest itself through hives, dermatitis, eczema, vomiting, swelling of the tongue and throat, etc. People who have such allergies should avoid consuming soybean oil and soy products.

Soybean oil contains trans fatty acids, which are considered unhealthy and appear after hydrogenation of the oil - a process by which hydrogen is added to provide stability to the product. Fresh soybean oil does not contain trans fatty acids. After hydrogenation, the oil loses an increased amount of vitamins and minerals.

It has an increased content of beneficial fatty acids for the body, as well as vitamins E and K. It contains trans fatty acids, which are considered harmful to the body.

Soybean oil provides a high caloric intake to the body, which can lead to weight gain if the recommended daily dose is exceeded [13-19].

Materials and methods

Soybean oil was loaded onto an FT-IR spectrometer (NICOLET iS50, Thermo Fisher Scientific, Kyoto, Japan) equipped with an attenuated total reflection (ATR) accessory for recording the FT-IR spectra. The OMNIC

program (version 8.2.0.387, Thermo Scientific, Waltham, Massachusetts, USA) was used to obtain all of the FT-IR spectra. Scans were recorded in order to obtain average analytical results and enhance the signal-to-noise ratio. Spectrum was scanned between 4000 and 400 cm±1 and had a spectral resolution of 4 cm±1.

Fig 1: Spectrometer NICOLET iS50

Results and discussions

Figure 2 shows the IR spectrum of soybean oil obtained with the Nicolet iS50 spectrometer.

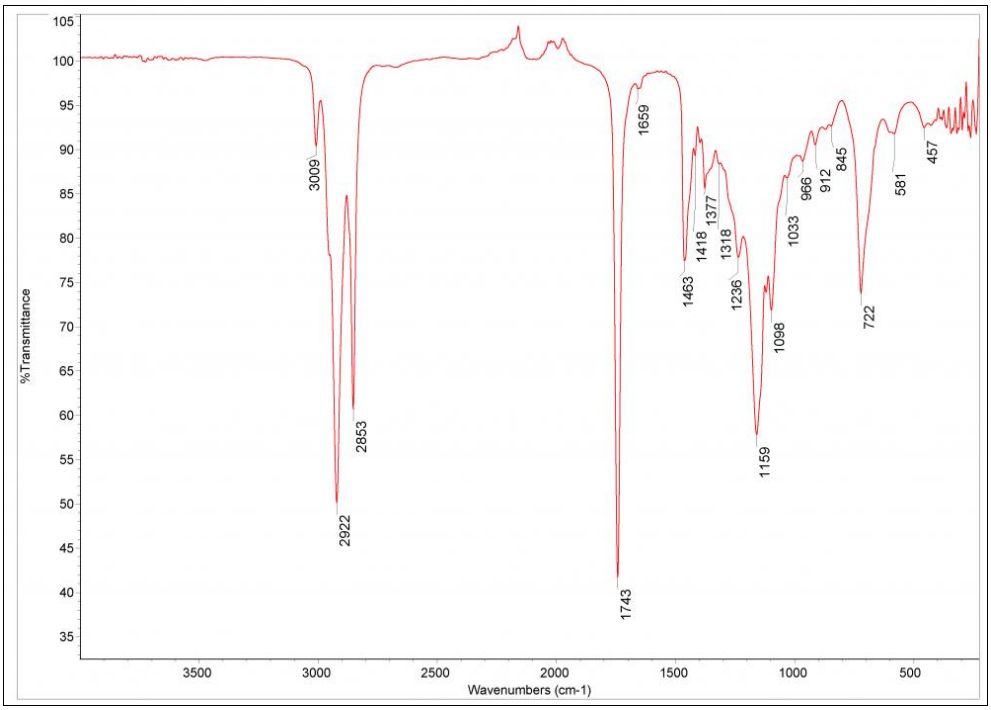

Fig 2: IR spectrum of soybean oil

Table 1 shows the peak assignments for soybean oil.

Table 1: FT-IR spectrum band assignments of oil soybean [20-26]

Wavenumber (cm^{-1})	Vibration	Suggested biomolecular assignment
3009	C = H stretching	Unsaturated lipids
2922	C-H stretching (asym)	Lipids (mainly), proteins, carbohydrates
2854	C-H stretching (sym)	Lipids (mainly), proteins, carbohydrates
1743	C = O stretching	Lipids
1659	C-O, C-N stretching	Amide I (protein
1463	CH2 bending	Lipids
1418	CH3 bending	Proteins
1377-1318	CH3 bending, COO- stretching (sym)	Proteins, Fatty acids, amino acids
1236	PO2- stretching (asym)	Amide III

1159	CO-O-C stretching (asym), C-O stretching	Cholesterol ester, Oligosaccharides, triacylglycerols
1098-1033	PO_2- stretching (sym), C-O stretching	Nucleic acids, Starch
966-457	O-C-O bending	CO_2

Conclusions

The composition of soybean oil contains absorption bands between wavelengths 3009 and 457cm-1. Soybean oil contains the following functional groups: C=H, C-H, C=O, C-O, C-N, CH_2, CH_3, COO, PO2, CO-O-C, C-O, O-C-O and were determined with the NICOLET iS50 spectrometer.

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