Sunflower Oil Extraction Using Supercritical Fluids

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Introduction

Sunflower seeds contain a high concentration of Vitamin E rich oil. The oil is advantageous for human consumption due to the high vitamin E content and the low amounts of saturated fat. The active component of Sunflower Oil Vitamin E is α-Tocopherol, an antioxidant that defends against ROS (reactive oxygen species). The α-Tocopherol is fat soluble and specifically prevents ROS damage during oxidations of polyunsaturated fatty acids in lipids.

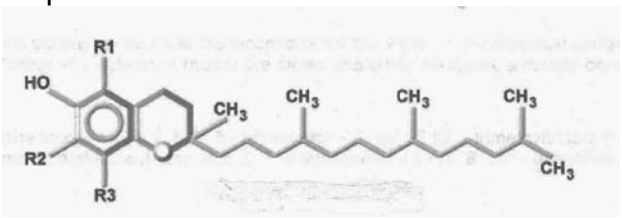

Fig. 1. α-Tocopherol

Sunflower seed oil is largely utilized by the food industry. The oil can withstand high cooking temperatures, making it an optimal choice for frying. It also has the additional health benefit of having lower saturated fat and highest vitamin E content than any of the other frying oils.

Sunflower seed oil is applicable as a lubricant and a cosmetic ingredient. It could potentially become a key component of vegetable oil fuel.

Currently, cold pressing is the preferred process for sunflower seed oil extraction. This process leaves a high amount of oil in the seeds, which is wasteful and unprofitable. SFT has developed a lab scale process to extract pure sunflower seed oil utilizing supercritical carbon dioxide and the SFT-110 SFE. This process yields completely "pure" sunflower oil.

First, SFT determined the general solubility parameters of the sunflower oil in the SFT-Phase Monitor II. The SFT-Phase Monitor II allowed exploration of the ideal matrix of extraction conditions. The SFE conditions were optimized to obtain the highest yield, best quality, and purest fraction. Then extraction parameters were perfected using the SFT-110 SFE.

The SFT-110 utilizes pressurized carbon dioxide, allowing extraction to take place in room temperature environments, so a purer, less thermally decomposed extract is generated. Carbon dioxide is also advantageous, because it does not introduce any residual organic chemicals, meaning that all extracts are safe to consume. Carbon dioxide extraction using the SFT-110 SFE can separate the oils in a clean, energy efficient fashion.

Equipment

- Analytical Balance
- SFT-110 SFE Unit
- SFT 100 cc Sample Vessel
- SFT 100 cc Sample Bag

MATERIALS

- Raw Sunflower Seeds
- SFT Collection Vial
- 1 SFT Vent Tube

Figure 1: SFT-110 SFE Unit

EXPERIMENTAL PROCEDURE

A simple SFE extraction method using the SFT-110 SFE was employed to extract sunflower seed oil from raw sunflower seeds.

Weigh 40 grams of the sunflower seeds on an analytical balance. Grind up pellets to 1mm x 1mm and load into the SFT 100 cc Sample Bag. Place the SFT 100 cc Sample Bag into a SFT 100 cc sample vessel (10kpsi, 200°C operation).

Seal the vessel and set into a SFT-110 SFE unit. The sunflower oil will be collected via multiple (9) soak and dynamic flow steps. Extract the sample according to the following parameters:

EXTRACTION PARAMETERS

- Pressure: 8700 psi
- Oven Temperature: 40°C
- Restrictor Temperature: 80ºC
- CO_2 Flow Rate: 10 mL/min
- 9 static and dynamic steps for 10 minutes apiece

After extraction, turn off the SFT-110 SFE according to manual instructions.

RESULTS

The sunflower oil extracts will yield a bright yellow product. A distinct sunflower seed odor radiates from the product more so than just the raw sunflower seeds. When you remove the raw sunflower seeds from the vessel, they should be pure white, almost as if they had been bleached.

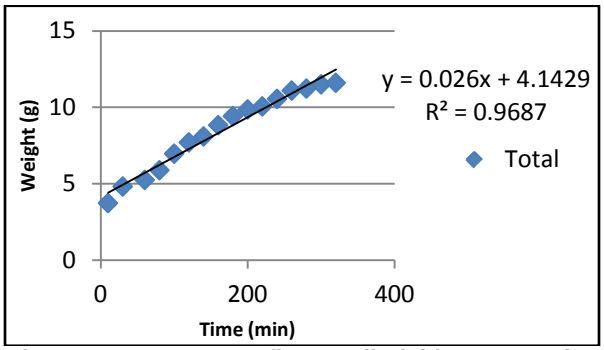

Figure 2: SFE-CO_2 Sunflower Oil Yield at 8700 psi

Figure 2 is the extraction yield results for the sunflower oil at 8700 psi. The recovery rate of oil was 32.65% successful. Oil rate will vary in success up to 40% of the total weight of sunflower seeds depending on what strain of seeds was used.

REFERENCES

Salgın, Uğur, Onur Döker, and Ayla Çalımlı. "Extraction of Sunflower Oil with Supercritical CO_2: Experiments and Modeling." The Journal of Supercritical Fluids 38.3 (2006): 326-31. Print.