Oilseed Fact Sheet: Processing Edible Oils

Introduction

Edible oils used in the Northeastern United States are primarily sourced from the Midwestern US and Canada. Oils used for salad dressing as well as those used for cooking uses such as deep fat frying and pan frying are all called edible oils. With an interest in locally and regionally produced foods, oils are another food type that can be regionally grown and processed. Sunflower, canola, flax, safflower and other oilseed crops have been successfully grown in the Northeast.

In a typical edible oil processing plant oil is extracted from the seed first using mechanical extraction (expeller press) followed by chemical extraction (hexane extraction). By using both methods less than 1% of the oil is left in the meal that is produced. The majority of this meal is sold for use in animal feed rations.

Components of Edible Oil

Many components are found in a typical vegetable oil (Figure 1). This figure shows what is in canola oil; other edible oils have varying percentages of the same constituents. Components listed as minor comprise less than 1% of canola oil, yet these parts play a large part in determining the stability, therefore shelf life, of the oil. Many of these minor constituents interact readily with oxygen in the air or other components in the oil to oxidize and form the products associated with rancidity. Other of these minor components are anti-oxidants, working to keep components from reacting with air to form the compounds associated with rancidity. The following table shows some of the minor components and their effect on oxidation. Anti-oxidants resist oxidation so help to preserve the quality of the oil; pro-oxidants promote oxidation so do not help to preserve the oil.

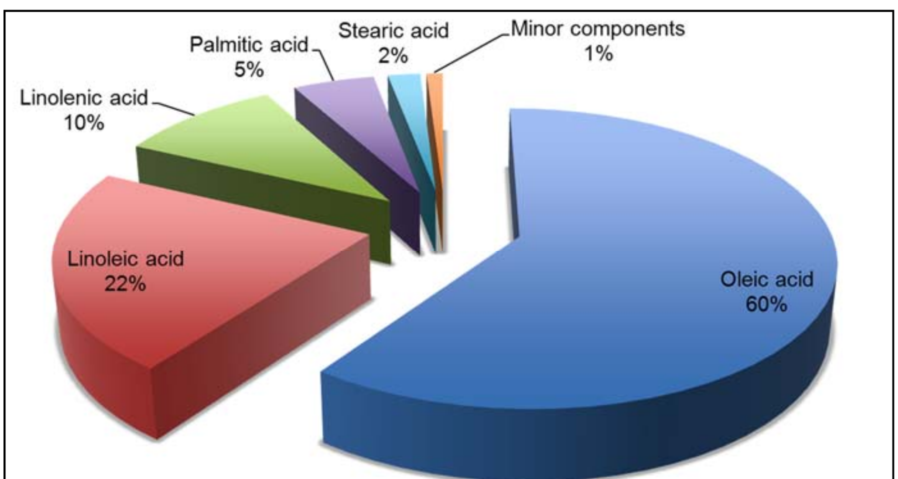

Figure 1: Components of canola oil

<u>Anti-oxidants:</u> resist rancidity

- Tocopherols (vitamin E)
- Carotenoids

<u>Pro-oxidants:</u> aid rancidity

- Water
- Transition metals (iron, copper)
- Polar lipids
- Chlorophyll

In general it is difficult to find a process that will remove the pro-oxidants without also removing the naturally occurring anti-oxidants. Looking at a label of commercially prepared oil often shows that after processing an anti-oxidant has been added to the processed oil to replace compounds that were removed during processing.

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Commercial Edible Oil Processing

The commercial edible oil processing system is usually different from that performed by small-scale edible oil producers. There are steps involved which the small-scale producer would not necessarily need or want to employ with their product. Figure 2 shows a simplified diagram of commercial oilseed processing.

Seed is planted and harvested as with any other crop. This is followed by the cleaning process, which removes unwanted materials such as soil and other seeds from the harvest. In some cases, it is preferable to shell the seed, removing hulls for a better quality final product.

At this point, if the seed is large, the seed is crushed or broken up into smaller pieces. These uniform pieces are then conditioned by heating before being pressed for oil. The two products of this process are the raw pressed oil and the press cake, which is the compressed dry material of the seed.

The raw oil is filtered before moving on to the final steps. The press cake, however, is flaked and broken down for additional oil extraction. The flakes are ground up and mixed with hexane to produce a slurry, which is heated. During heating, the hexane evaporates, and is collected for further use. While being heated, the meal releases the remaining oil, which is mixed with a small amount of hexane that did not evaporate.

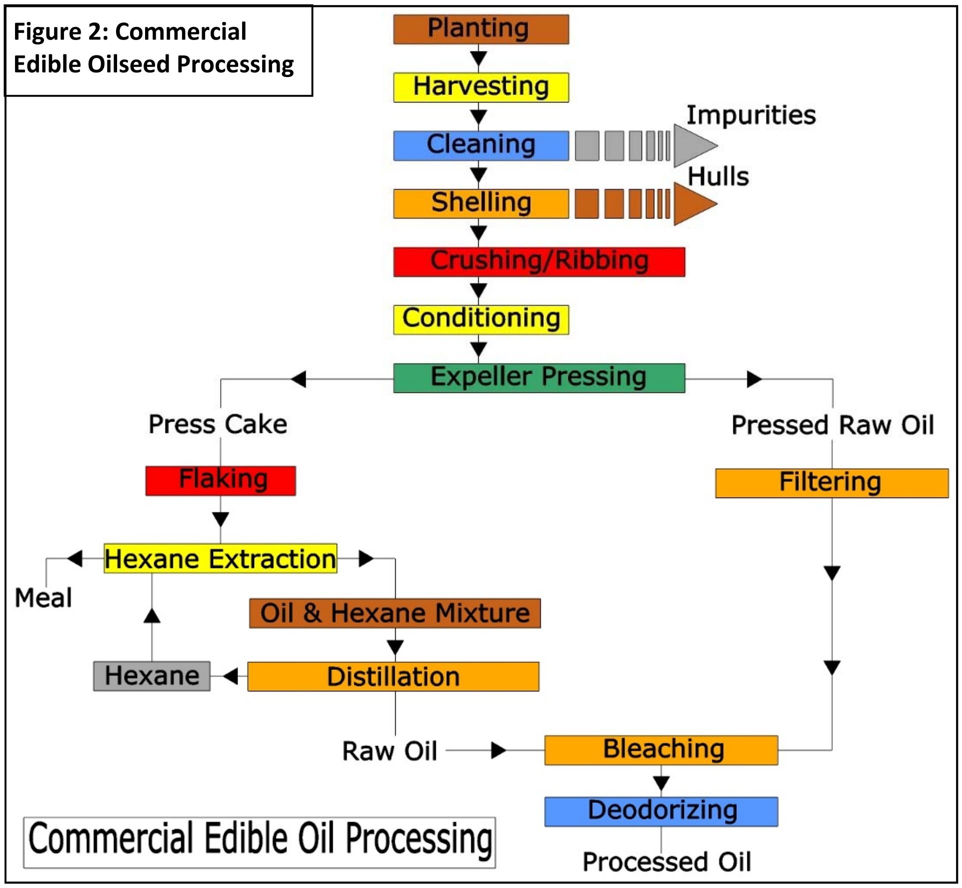

Figure 2: Commercial Edible Oilseed Processing

The meal is then taken for other uses, such as a portion of the feed for cattle. The oil and hexane mixture is distilled, and the hexane removed and collected.

The remaining oil and the oil from the initial pressing process are bleached using bleaching clay, and deodorized , leaving the oil in its final state which is packaged and sold. This entire process contains several procedures which the small-scale producer may not need or desire for their final product

Cold Pressed Oils

Small-scale pressing using expeller presses results in more oil being left in the meal than results from chemical processing. Typically, the oil in the meal from small-scale pressing is in the range of 8—15%. Commercial processing leaves less than 1% oil in the meal. While extracting the most oil as possible from the seed is one goal, often producing oil at a temperature less than 49 C (120 °F) is also an important objective. Oil pressed at this temperature below 49 C (120 ° F) is known as “cold-pressed” oil and is desired for alleged increased nutritional properties. Cold-pressed oil is also important if the oil is to be used directly as engine fuel because an oil pressed at a lower temperature carries lower levels of phosphorous. High levels of phosphorous in the oil can be harmful to a diesel engine and is one of the compounds with a maximum limit set in the standard for vegetable oil for use as engine fuel.

RBD Oils

Edible oils purchased in stores are known as "RBD" oils. These are oils that have been Refined, Bleached and Deodorized. Each of these steps is used to create a final oil that is consistent in taste, color and stability. As a result, these oils are generally tasteless, odorless, and colorless regardless of the original oilseed type or quality. While this is the intent of the processing, a locally produced oil may not need to meet the same expectations as the mass-marketed oils.

Small-scale pressed oils that have not been processed or are minimally processed retain flavors and smells common to the original oilseed. For example, sunflower oil that is minimally processed retains a characteristic sunflower flavor and will pass this on to the salad dressing or foods fried in this oil.

For deep fat frying, RBD oils are designed to stand up longer to the long term high heats demanded in these applications.

Processing of edible oils is often broken into the three RBD categories: refining, bleaching and deodorizing. Each of these steps used in large scale processing may be duplicated on a smaller scale. Some are more difficult to implement on a small scale, and may not be justified depending on the market for the end product.

Refining

Refining of oils may include neutralization of fatty acids, removal of phospholipids (a compound containing phosphorous), and filtering of the oil. Other processes may also be carried out to create a more stable oil for subsequent processing. On a small scale, removing hydratable and non-hydratable phospholipids is one goal, while removing particulates through filtration is a second objective. Hydratable compounds are ones that will dissolve in water. Non-hydratable compounds will not dissolve in water, and will often settle out or be removed by filtration. There is a small amount of water in edible oils, so water is present to dissolve the hydratable compounds. Refer to the "Oilseed Fact Sheet: Filtration" for more information on filtering edible oils.

A simple acid wash of the raw pressed oil will cause many of the hydratable compounds to settle out of the water and become particles that can be settled, centrifuged or filtered from the remaining oil. Citric acid is often chosen as the acid for this operation. In one process, the oil is heated to 80 °C (176 °F). The oil is then mixed in a solution of 2% citric acid, 98% oil. The acid is composed of a solution of 30% acid with 70% water. This total mixture is kept at 80° C for up to 15 minutes, then rapidly cooled, settled, and separated via centrifuge. Commercial operations may include additional processes in the refining stage.

Figure 3: A bag of bleaching clay.

Bleaching

Oils have a characteristic color when initially pressed. When present on a grocery store shelf, vegetable oils from different seeds have the same nearly colorless appearance. These oils have been bleached to remove the minor constituents that cause the color. Other components, some of them desirable, are also removed during bleaching.

Bleaching removes the oil compo-

Figure 4: Two different types of bleaching clay. Shown on the left is a sample that is mixed with the oil, heated, and put through a filter press. On the right is a sample that is used as a filter in itself, which the oil is passed through. In both cases, the unwanted components in the oil are bonded with the clay, removing them.

nents that increase the rate of oxidation. When oil is used at high temperatures, for example when pan frying or deep-fat frying, oxidation is accelerated and the oil may develop undesirable characteristics such as off flavor or dark color quickly. Bleaching allows the oil to be used for a longer period of time before these undesirable characteristics occur.

To accomplish bleaching, the oil is mixed with the required amount of bleaching clay (Figures 3 and 4). This mixture is heated to a high temperature [90 °C (194 °F) to 110 °C (230 °F)] in the absence of oxygen (air) and mixed. The undesirable (and desirable) compounds in the oil attach themselves to the bleaching clay particles. Filtering or centrifuging removes the clay particles and the compounds attached to the clay, resulting in an oil that has the colorant compounds removed (Figure 5). Bleaching clay is a type of clay dug primarily in the southern United States. It may be either natural clay or activated with an acid wash. Activated clay will attract and hold more compounds than natural clay. Natural clay is used for bleaching of certified organic oils.

Deodorizing

When pressed, oils contain a variety of components. These include vitamins, fatty acids, protein fragments, traces of pesticides, and occasionally heavy metals, as well as many other materials. The majority of these either enhance or detract from the flavor and smell of the oil.

The process of deodorizing removes all of these components from the oil, leaving it flavorless and odorless, essentially the same as other oils which are deodorized. This process involves steaming the oil, which vaporizes the unwanted components and separates them from the desired material. For the small-scale or local producer, this process may not be desired, for several reasons. Deodorizing removes flavor and odors which are often prized in oils, enhancing the flavor of the foods they are used to prepare. Also, this process requires additional equipment which can be costly to purchase and maintain.

Figure 5: Bleached canola oil (left) and un-bleached canola oil (right) are very different in color due to the natural colorants removed during bleaching.

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Summary

Edible oil contains a variety of components and features, which all play a part in its refinement and qualities. When commercially processed, edible oil is colorless, odorless, and flavorless, with few of its original qualities.

The small-scale edible oil processing setup contains many of the same features but may leave out steps used in commercial processing, such as bleaching and deodorizing. This allows the oil to retain its original flavor, odor, and coloring. These are often desired traits in locally grown or small-scale oils, as they enhance the foods the oil is used to prepare.

Resources

Vegetable oil processing equipment
Tinytech (www.tinytechindia.com)

Bleaching clays
Oil-dry corporation
http://pure-flo.com/products.html

Introduction to Fats and Oils Technology: Second Edition. AOCS Press, 2000.

Article discussing degumming and acid washes
Acta Chimica Slavaca Vol. 1, No. 1, 2008, 321-328

Northeast Oilseed Information
University of Vermont:
www.uvm.edu/extension/cropsoil/oilseeds

Note: This is not an exhaustive resource list nor do any of the oilseed project partners endorse any of the products or companies on this list. It is intended as a resource and starting point for those interested in small-scale oilseed processing.

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