



Oilseed Processing for Small-Scale Producers

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There are many varieties of seeds and nuts that can produce oils for food, nutraceuticals, skincare products, aromatherapies, fuels, and industrial lubricants. This publication describes the basic processes involved in oil processing, including seed cleaning, extraction, clarification, packaging, and storage. Sources for more information and equipment are included in the References and Resources sections at the end of the publication.

Introduction

Farmers and small-business owners are asking if it is possible and profitable to add value to their seeds and nuts by extracting the oil. This is not an easy question to answer because there are so many variables, some of which are noted in the following sections of this publication.

Culinary oils include olive, sesame, safflower, sunflower, grape seed, canola, apricot kernel, soybean, corn, coconut, hazelnut, peanut, pumpkin, and walnut oils. Some of these plant-derived oils can be used to make soap, body and hair oils, detergents, and paints. Some can also be used to make industrial lubricants. Other oilseeds and oil-producing plants are high-quality feedstocks for biodiesel and straight vegetable oil (SVO) fuel. Oilseed processing expands the use of crops such as sunflowers and brings value to grape seeds, which are usually waste products.

Most oil processing in the United States is done on a large industrial scale. Small-scale oil extraction is more commonplace in other parts of the world. As a result, many of the useful resource materials and much of the appropriate-scale machinery come from other countries. This publication describes the basic processes of oilseed production, with extensive sources for additional information and equipment.



Safflower oil. Photo: NCAT

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Getting Started

Former culinary-oil businessman and consultant E. Peter Matthies, now living in Aachen, Germany, suggests that you ask yourself the following questions before starting oil processing:

- Why do I want to start oil processing?
- Will it be a hobby or a new economic enterprise?
- How big will the operation be?
- How many different products will be made, including both oil and the press cake left after the oil is pressed out of the raw seeds or nuts?
- Do I want to target mass markets or specialty markets?
- What geographical area do I want to cover?

There are still more questions to consider, including the following:

- Who else makes cooking oil?
- Where will I set up my business?
- What equipment will I need?
- Will I employ others?
- Do I have experience for this venture? If not, where do I get reliable training, technical assistance and advice?
- Where will I get the capital to start my oil business? (Fellows and Axtell, 2012)

The very first question is important because it affects the answers to all the other questions. It even affects how you read this publication. If you crush oilseeds for biodiesel or straight vegetable oil fuel production, you need to pay special attention to several specific processing steps.

For culinary oils, there are several more processing steps and technologies to consider and possibly add to your plan. You may forego some of the more complex, costly steps for exclusively personal-use cooking oil or biofuel.

Basic Processing Steps

Seed Cleaning

Preparation of the raw material often includes removing husks or seed coats from the seeds and separating the seeds from the chaff. There are many small- to intermediate-scale approaches to and technologies for effective seed cleaning. Approaches range from using various sizes of hardware cloth screens in tandem (Clothier, no date) to using a compact fanning mill such as the Clipper Office Tester and a spiral separator for small farms (Anon., 2008). See the Further Resources section for examples, types, and sources of equipment.

Seed Preparation and Conditioning

For successful pressing, the seed must have the following characteristics:

- **Clean.** Fine dust in the seed may clog the oil press hardware. Chaff left in the seed will absorb some of the oil and keep it from getting squeezed out of the expeller. Sand in the seed will wear out the press. Stones damage the oil press screw or piston.
- **Dry.** Moist seed leads to low yields and clogs the screw or cage, a part of the press. Moist seed may also get moldy, as mold spores are present in all crops. A rule of thumb is that

the moisture content of the seed should be close to 10%. The number varies considerably for specific oilseeds. For example, rapeseed should be dried to a 7% moisture content, camelina to about 6%, and sunflower to 8.5%. Safflower needs only to be dried to 11%, and soybean is safe for storage and processing at 12% (Alam, 2007).

There are at least two methods of testing seed moisture levels. Hand-held moisture testers allow the user to simply place the seed in the tester, turn it on, and select the type of seed to test. The tester provides an instant readout. These testers cost as little as \$200. Brand names include Dickey John Portable Grain Moisture Tester MG3, the Graintec HE-50, and GE Sensing's Protimeter Grainmaster.

Here is a lower-tech, low-cost way of moisture testing: Weigh a sample of seed, and then heat the sample in an oven at 300°F for one hour. Reweigh the sample. The weight lost in the oven is equal to the moisture content of the original sample. Calculate the percentage by dividing the weight lost by the original weight and multiplying the result by 100.

Even dry seed can quickly get damp by being in contact with damp earth. Once the seed is dried and bagged, it must be stored carefully to keep it from absorbing moisture.

- **Warm.** Warm seed will yield the most oil for the least effort. The optimum heat range for oil extraction is from 100°F to 160°F. There are several ways to preheat the seed in advance of extraction. For very small batches, heating the seed in an oven or double boiler works, as does concentrated sunlight in a solar food dryer or some other solar collector. For larger batches, a heating element in a hopper located between the seed-storage facility and the oilseed press works well.

Extraction by Cold Pressing

Oil can be extracted mechanically with a ram press, an expeller, or even a wooden mortar and pestle, a traditional method that originated in India. Presses range from small, hand-driven models that an individual can build to power-driven commercial presses. The ram press uses a piston inside a cage to crush the seed and force

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out the oil (Herz, 1997).

Expellers have a rotating screw inside a horizontal cylinder that is capped at one end. The screw forces the seeds or nuts through the cylinder with gradually increasing pressure.

The seed is heated by friction and electric heaters or a combination of the two. Once the cap is removed, the oil escapes from the cylinder through small holes or slots and the press cake, or meal, emerges from the end of the cylinder. Both the pressure and temperature can be adjusted for different kinds of feedstock.

There are two distinct expeller-press designs — a single-cylinder press that expels the press cake out in pellet form and a traditional cage-style screw press that expels the meal in large flakes.

Oil Expellers

There are many manufacturers of single-cylinder presses. Most presses are sold in European countries and designed primarily for rapeseed, or canola. For example, the Täby Press is a screw press manufactured in Sweden. It is similar to the Komet Oil Expeller described below. Various models are available for cold-pressing rapeseed, linseed, flaxseed, sunflower seed, sesame seed, peanut, groundnut, mustard seed, poppy seed, cotton seed, jojoba, and more.

Komet Vegetable Oil Expellers are manufactured by IBG Monforts in Germany. The company's range of products covers small hand-operated machines as well as industrial machines. According to product literature, Komet oil expellers feature a special cold-pressing system with a single conveying screw to squeeze the oils from various oil-bearing seeds.



Photo: Ken DeBoer

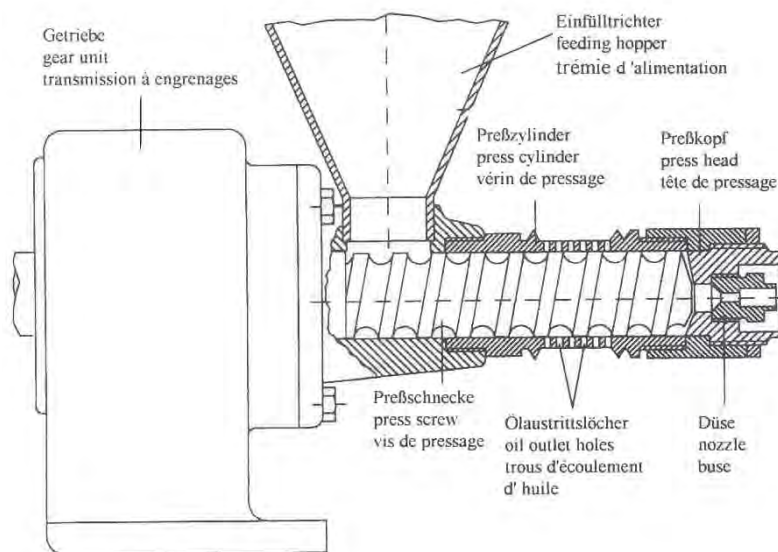


Figure 1. Sectional view of a Komet (single cylinder) oil expeller. Source: IBG Monforts

The machines operate on a gentle mechanical press principle that does not involve mixing and tearing the seeds. Virtually all oil-bearing seeds, nuts, and kernels can be pressed with standard equipment and without adjusting the screws or oil outlet holes.

Some advantages and disadvantages of each type of press follow:

Single-cylinder

Advantages:

- Simple to use and adjust for multiple feedstocks
- Designed for continuous use
- Easier to unclog if it gets backed up, which happens occasionally
- Works quite well out of the box.

Disadvantages:

- Not for use for large, industrial-scale presses due to the very large pressure generated on the press head
- Expensive

Cage-style

Advantages:

- Less expensive for small and large electric-driven presses
- The expeller of choice for larger capacities of more than three tons per day

Disadvantages

- Difficult to adjust for different sizes of seeds
- Needs more constant monitoring

If you want to process larger amounts of oilseed crops, a 3-ton to 10-ton per day cage press may be what you want. You can also link multiple cylinder presses in tandem to perform the same function. Another option is the Instapro press, which is a semi-industrial-scale press available in the 20-ton per day capacity.

Both cylinder and cage presses have significant electrical requirements. Any press with a capacity of more than three tons per day will likely require three-phase power, and smaller presses require 220-volt power.

Choosing the correct size of press for what you intend to do is very important. For example, Montana farmers' experiences led to the conclusion that 1-ton-per-day presses are too small for what is needed to produce biodiesel or straight vegetable oil fuel on an average Montana grain farm. Furthermore, farmers who bought small, imported Chinese models reported lower-than-expected quality and considerable setup time.

Solvent Extraction of Oil

Oils can also be extracted with solvents, but solvent extraction is a complex and costly operation. Solvent extraction isn't suited for small-scale processing because of high capital and operating costs, risks due to fire and explosions from solvents, and the sheer complexity. Management of solvents such as hexane is an environmental challenge, as well (Swetman, 2008).

Clarification

Clarification removes contaminants such as fine pulp, water, and resins. You can clarify oil by allowing it to sit undisturbed for a few days and then removing the upper layer. If the oil needs further clarification, filter the oil through a fine filter cloth. Finally, you can heat the oil to drive off traces of water and destroy any bacteria.

Degumming

Degumming is the process of removing the phospholipids from the oil. Many people advise that you allow the resulting oil to settle out the gums, or hydratables, over a period of one to two weeks. However, you need more chemical processing to make high-quality culinary oil or biodiesel feedstock.

Refining, Bleaching and Deodorizing

The vegetable oil produced and processed to this point does not need refining, bleaching, or deodorizing as long as the natural taste, smell, and color are acceptable to the user. However, getting the oil to commercial food grade may be an important step in oilseed processing if your market demands it. For example, restaurants require oils that have a relatively high smoke temperature and may or may not want the taste of the natural oil. Getting the oil to food grade will add value and can make small-scale biodiesel from

oilseeds more feasible for those who intend to use the oil in a manner similar to the full-cycle farming story at right.

The RBD process gets oil to commercial-grade specifications. The RBD process includes these steps:

- **Refining.** Refining usually consists of two steps. The first step is degumming, which is described above. The second step is neutralization, in which the free fatty acids (FFAs) in the crude oil are caustic-stripped with sodium hydroxide (NaOH) in an aqueous solution. The resulting soap stock is settled, filtered, or centrifuged out (Van Gerpen et al., 2006).
- **Bleaching.** In this step, the oil is mixed with certain types of bleaching clays to absorb colors and some other contaminants such as soap, trace metals, and sulfur compounds.
- **Deodorizing.** This is a distillation process that occurs at high temperatures and low pressure (Van Gerpen et al., 2006). The oil is put under a vacuum and heated with steam to remove any leftover taste or odors and FFAs. Deodorizing can also be achieved by treatment with activated charcoal (Pilgeram, 2008).

RBD is not always beneficial to nutrition. Crude oil contains more vitamin E, trace elements, phytosterols, and other nutrients. The trade-off is that crude oil is healthier but less stable (Pilgeram, 2008).

Oil Packaging and Storage

Use clean, dry containers to package and store oils. Sealed glass or plastic bottles are adequate for small quantities. Colored containers stored in a dark box help increase shelf life. Steel or plastic

tanks work well for large quantities. The shelf life of oil is usually six to 12 months if it is properly packaged and kept away from heat and sunlight (Fellows and Hampton, 2003).

Keeping air away from oil is perhaps the most important step to prevent rancidity. Completely fill whatever size container you chose so there is no air space and then cap the container tightly (Van Gerpen, 2008).

Shelf life of oil may vary depending on the type of oil as well as the storage conditions. For example, flax and grape seed have a shorter shelf life than canola or sunflower, due to the large amount of polyunsaturates present.

If the stored vegetable oil does not reach sustained temperatures of 100°F or more, its vital components will be preserved. Therefore, vegetable oil is excellently suited for natural nutrition. As long as the oil is stored in a dark, cool place, it will have a long shelf life.

Oilseed By-products: Meal and Hulls

Soy hulls and sunflower shells removed before pressing are used as animal feed. Soy hulls are used as a replacement for corn or winter hay.

Seed meal is a valuable by-product of pressing oilseeds. Sesame seed cake is valuable as a human food. Sunflower seed cake is not suitable for people, but it makes a good addition to chicken, pig,



These safflower oil containers are stored in a cool, dry, north-facing building to maximize the oil's shelf life. Photo: NCAT

or cattle feed. It is quite high in crude protein, but contains very few carbohydrates. It should be used as a feed additive, not a feed by itself.

Canola, camelina, soy, and safflower meal are also used as animal feed supplements. For example, the U.S. Food and Drug Administration has approved camelina feed ration rates as high as 10% for beef cattle and poultry (Shafer Commodities, 2018). Table 1 shows the nutrient levels of various oilseed meals.

What's in the meal?

Be clear on oil content of the oilseed and the cake. Crushing the whole seed, rather than dehulling it before pressing, increases the fiber levels. All of the numbers describing the various oilseeds on the next page are the oil, or fat, content of the meal. The words "fat" and "oil" are interchangeable.

Keep in mind that any variability in an oilseed crusher's efficiency and effectiveness in removing the oil will affect factors such as feed ration recommendations and shelf life. For example, canola seed is about 40% oil, based on methods that extract virtually all the oil, usually solvent extraction. However, if cold pressing canola gets only 70% of that 40%, the amount of oil left in the cake is more than what a processor that removes 85% of the oil would leave.

Meals of the oilseeds in the brassica family contain glucosinolates, which are organic compounds that function as natural pesticides and give brassicas their bitter taste. Glucosinolates have anti-nutritional qualities that block absorption of some nutrients. Mustard meal has very high levels of these compounds. Camelina and canola have much lower levels, making them far more suitable for feeding.

Soybeans contain trypsin inhibitors that need to be deactivated by cooking before animals can derive the full value of the protein in the meal (Van Gerpen, 2008). There is a large body of literature on what meals are best suited for ruminants or for monogastrics like swine and poultry. See the Further Resources section for a sample of those sources.

Table 1: Nutrient composition of various oilseed meals resulting from solvent or mechanical extraction.*Source – Biodiesel Benefits for Cattle Producers: Feeding Byproducts of Biodiesel Production (Lardy, 2008).*

Dry matter basis									
	DM %	CP %	Fat %	TDN %	NEm, Mcal/lb	NEg, Mcal/lb	ADF %	Ca %	P %
Camelina meal, mechanical extraction	91.5	36.5	14.1	88.6	.97	.64	19.2	.38	.77
Canola meal, mechanical extraction	90	41	7.4	76	.8	.52	16	.6	.94
Canola meal, mechanical extraction, On-farm press	92.6	36.9	14.1	88	1.09	.77	NG	.6	1.02
Canola meal, solvent extraction	90	43.6	1.2	69	.73	.45	18	.67	1
Mustard meal, mechanical extraction	93	34.5	5.5	73	.76	.48	NG	NG	NG
Safflower meal, mechanical extraction	91.9	23.5	7.2	56.1	.55	.25	NG	.26	.66
Safflower meal, solvent extraction	92	25.4	1.1	57	.55	.29	41	.37	.81
Soybean meal, mechanical extraction	90.7	46.7	5.2	84.9	.94	.62	NG	.31	.65
Soybean meal, solvent extraction	89	49	1.2	84	.94	.64	NG	.33	.71
Sunflower meal, mechanical extraction, On-farm press	93.1	23.6	19	90.5	1.13	.8	NG	.43	.79
Sunflower meal, solvent extraction	90	38.9	1	64	.65	.35	28	.39	1.06

Abbreviations: DM = dry matter; TDN = total digestible nutrients; NEm = net energy for maintenance; NEg = net energy for gain; CP = crude protein; ADF = acid detergent fiber; Ca = calcium; P = phosphorus; NG = not given.

Just as with oilseeds, proper storage of seed cake is extremely important. Moldy seed cake is a two-fold problem. First, moldy seed cake does not taste good to animals. Animals may not be willing to eat moldy feed. Worse, some kinds of mold make mycotoxins such as aflatoxin. These poisons can make people and animals sick. Some of the poisons from moldy seed will end up in the oil, but most remain in the seed cake. The toxins can also get into the meat, eggs, and especially the milk of the animals that eat the cake.

Rancidity is another shelf-life issue for oilseed cake. Shelf life of meal is most affected by the content of unsaturated fatty acids and the content of antioxidants such as vitamin E and derivatives. Unsaturated fatty acids, such as omega-3s, decrease the shelf life. Antioxidants increase shelf life. Storage, temperature, humidity, moisture content and seed type are also important factors to consider. For example, camelina and flax both have high concentrations of omega-3 fatty acids. However, camelina meal contains higher concentrations of vitamin E and subsequently

has a longer shelf life than flax meal. Canola oil contains less unsaturated fat than camelina oil. Subsequently, canola meal is more stable (Pilgeram, 2008).

Adding Value Adds Costs

Although value-added processing can be a way to increase a farmer's share of the farm-product dollar, adding value doesn't come free. At each step, one is adding more work, buying additional equipment and supplies, and using more energy. Information needs also increase. Wholesaling or retailing culinary oil will require nutritional labeling. And depending upon the situation, liability insurance may become a must.

A key point to remember is that adding value to any foods by processing increases safety risks due to the increased handling. Therefore, rules and regulations are established by each state to protect public health. In addition, the U.S. Food and Drug Administration regulates products going out of state. Anyone considering processed foods as a value-added business should contact the state health department before proceeding.

Oils as Food AND Fuel: A (Bio) Oilman's Story

Like many farmers in the mid-2000s, Bob Quinn of Big Sandy, Montana, decided that he'd had enough of high diesel-fuel prices. He knew he could grow oilseeds that could power his farm equipment when properly processed. This started a long learning process that continues to evolve to this day.

Initial Crop Selection

Quinn knows his North Central Montana farm and the surrounding agro-ecosystem very well. He knew that canola was better suited for land northwest of Big Sandy than for his location. He tried camelina because it showed promise as a low input, cool-season oilseed that bloomed early. But Quinn found out that camelina has some undesirable characteristics, and that led him to switch to safflower. Safflower had been grown south of Big Sandy, but due to the very long season needed to get a mature crop, interest had faded by the time Quinn took over the farm from his father. However, changing weather patterns with warmer autumn temperatures allowed Quinn to raise this late-maturing crop successfully.

How to process?

Quinn quickly found out what other farmers were learning at the same time – that cheap oilseed presses are “expensive boat anchors.” Poor construction, poor machining, and poor output were his first oilseed press's better qualities. Fortunately, the person who encouraged him to buy that press graciously bought it back from him. Quinn then invested in German-made Monfort oilseed presses. With set-up and troubleshooting assistance from Peter Mathias (mentioned elsewhere in this publication), Quinn got these presses working effectively. Three double presses can produce about 100 gallons of oil in a 24-hour period.

Is fuel from oilseeds really a good idea?

Quinn wanted “to run the farm on oilseeds.” Making on-farm biodiesel is laudable but complex, and the input costs of making biodiesel increased in 2008 as petroleum prices started a steep decline. He switched from making biodiesel to using straight vegetable oil (SVO) fuel, but that required making other changes as well.

Quinn retrofitted his 1998 Caterpillar tractor with an Elsbett conversion kit that preheats the vegetable oil to 160°F before switching over the engine from conventional petro-diesel. He also switched from camelina because its polyunsaturated, high-Omega-3 fatty-acid profile was unsuitable for SVO fuel.

Quinn had to switch to an oilseed that had high oleic, monounsaturated fatty acids – either sunflower, safflower,

or canola. He tried sunflowers but had some difficulty in crushing and processing this seed. He sold the sunflower oil to a soap maker for \$1.25 to \$1.30 per pound. Safflower showed it had the highest potential for growth.

Using safflower as SVO fuel was working well, but two events led to still another change on how the farm would proceed. Quinn's employee had taken some of the cold-pressed, unrefined safflower oil to the Big Sandy delicatessen for them to use in their fryers. When the deli owner raved about the oil and asked for more, Quinn knew he might be onto something new. The restaurant would pay \$2.00 per pound for safflower oil. What made more sense? To crush safflower for fuel, which—at the time—was a relatively low-value bulk commodity? Or sell that same oil for food at many times the fuel price? In Bob Quinn's active mind, the answer was “both.”

Cleaning Used Cooking Oil for Fuel

Utilizing used cooking oil for biodiesel or SVO fuel can be very tricky and create costly surprises. For example, one farmer in Washington lost a diesel tractor to biodiesel made with recycled restaurant fry oil. He concluded that the ingredients used to coat curly fries made it through the processing, contaminating the biodiesel. As noted in other literature, not knowing exactly what is in the used oil leaves one open to problems with the wrong types or too-high levels of free fatty acids, as well as unwanted additives designed to reduce foaming.

Bob Quinn will only use recycled safflower oil for SVO fuel. The returned oil is washed and then dewatered. The small amount of water from frozen or fresh food is removed by boiling it off in hot water under a vacuum that allows the water to boil at 150°F. The hot oil is run through a centrifuge, and then filtered down to a range of three microns to remove impurities.

Closing the Loop with Food to Fuel

One of the arguments against using crops as fuel is that those crops should be used to ensure food security for everyone, and NOT divert valuable farmland resources to fuel production. Working with Montana State University-Northern in nearby Havre with a small grant from the Western Sustainable Agriculture Research and Education Program (SARE), Quinn was on his way to devising a plan and system to use safflower for food first and *then* fuel.

The oil would be sold to restaurants, institutional food services, and other buyers within a reasonable distance of the Big Sandy farm. These buyers would use the oil in their fryers and store the used oil for pickup when the next fresh safflower-oil delivery was made. Hence, Oil Barn was born.

The Oil Barn started in 2013 and is currently managed by

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Trevor Wilkerson. The Oil Barn crushing, packaging, and storage facilities are located at the Quinn Farm. After the safflower is crushed, the oil is run through a filter press to remove impurities. There is no other bleaching or refining, and there are no additives to the oil. The safflower oil is sold in 5-gallon containers to the Montana State University and University of Montana food services, as well as restaurants and other buyers in Montana. It is delivered monthly to these outlets. Another large customer is Botany Soap in Missoula, Montana. This company makes organic soap but does not return oil for the oil reprocessing.

The Oil Barn sells 16-ounce and 24-ounce bottles of safflower oil. Wilkerson says that the retail line is intended to build brand visibility as well as be another income stream for



The filter press (foreground) screens out impurities and debris left in the oil after crushing by the presses. Photo: NCAT

the business. The Oil Barn sells its organic-safflower oilseed cake to Organic Valley's network of dairy farms. The company has found that the non-organic safflower seed cake is more difficult to sell, even though it tests at 22 to 24% protein, 7% fat content, and it stores well. This is one of the reasons that the Oil Barn is phasing out its non-organic oil in the next year or two.

The high-oleic-acid content (80 to 86%) of the safflower makes for a very stable oil and seed cake that can keep up to 18 months.

Some of the Other Lessons along the Way

"This has been one big experiment," Quinn says with a smile.

His advice to others includes the following:

- Don't let the seed get too dry, as cited elsewhere in this publication. The optimum level for safflower is 11% moisture. Quinn found out the hard way that 9% safflower seed was too dry to process successfully.
- Having very clean seed is important, and organic seed is harder to clean than conventionally raised seed, mainly due to increased weed debris in the organic crop.
- Investing in and testing for seed quality is VERY important. Watch or test for sprout damage in the seed before crushing it. This is easier said than done because sometimes oilseed can sprout without showing any visible damage. Sprouted seed renders bad-tasting oil.
- Experiment with different oilseed press speeds to find what is optimal and most efficient for what you are processing. Manufacturers' recommendations do not always align with what actually yields the best oil quantity and quality.
- "Closing the loop" by getting used oil back from restaurants and institutional food services is complex. Small buyers don't have the storage capacity or space to segregate and save oil for the Oil Barn.
- SVO isn't suitable for diesel engines without some careful processing of the vegetable oil and modifications made to the engine itself, such as adjusting the timing and installing a special tank and equipment for the SVO (Anon., 2018; Riggins, 2018). It is beyond the scope of this publication to describe all of the required modifications and processing requirements. Check the References section for one source of more detailed information.

What the Future Holds

Although safflower-oil production, distribution, and reuse is the core of the Oil Barn's business, more change is in the wind. In 2017, industrial hemp production became legal in Montana under the auspices of the Montana Department of Agriculture. The Oil Barn is positioning itself to process hemp oil for culinary and cosmetic purposes. The company's preliminary trials with hemp seem to indicate very little difference between safflower and hemp-seed oilseed processing. The hemp seed cake is slated for human consumption as a high-protein supplement. Unlike safflower cake—which has a bitter taste—hemp seed cake has a sweet, nutty flavor.

Conclusion

Oilseed processing requires careful planning and searching out the expertise and equipment most suited for what you may have in mind in terms of the oil's purpose and use. For smaller-scale producers seeking to use low-cost technology, information resources and equipment from countries other than United States may initially be of higher value in getting started. The

resources listed below draw from a wide range of universities, businesses, and non-governmental organizations from around the world.

Note: Mention of specific brand names or companies is for educational purposes only and does not constitute endorsement by NCAT, ATTRA, or USDA.

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Further Resources

Publications

Enterprise Works /VITA, a division of Relief International
818 Connecticut Avenue NW, Suite 600
Washington, DC 20005
202-639-8660
202-639-8664 FAX
dc@ri.org
<http://enterpriseworks.org/display.cfm?id=5&sub=23>
<http://enterpriseworks.org/pubs/VITA%20Publications-%20Revised%2010.07.pdf>

Two relevant publications are for sale through EWW/VITA Publications.

* Understanding Pressure Extraction of Vegetable Oils.
Casten, No date. By James & Dr. Harry E. Snyder. EWW/VITA Publications. TP #40.

* Understanding Solvent Extraction of Vegetable Oils.
No date. By Nathan Kessler. EWW/VITA Publications. TP #41.

Final Report: On-farm Oilseed Biodiesel Production. 2007. By Vern Grubinger. University of Vermont Extension Service. www.uvm.edu/vtvegandberry/Pubs/Final%20Report%205-15-2007.pdf

How to Process Oilseeds on a Small Scale.
www.howtopedia.org/en/How_to_Process_Oilseed_on_a_Small_Scale

Practical Action Publishing
The Schumacher Center
Bourton on Dunsmore
Rugby, CV239Q2
UK
+44 (0)1926634400

<https://answers.practicalaction.org/our-resources/collection/nut-processing-and-oil-extraction-2>

Practical Action has several downloadable publications on this topic:

- * Essential Oils. 2008. By Tony Swetman. *Practical Action Publishing*. (545K PDF)
- * The Manual Screw Press for Small-scale Oil Extraction. 2008. By Andrew Russell. *Practical Action Publishing*. (180K PDF)
- * Oil Extraction. 2008. By Tony Swetman. *Practical Action Publishing*. (544K PDF)
- * Small Scale Oilseed Processing. 2006. By Barrie Axtel and Neil Noble. *Practical Action Publishing*. (370K PDF)

Setting Up and Running a Small-Scale Cooking Oil Business. 2012. Edited by P.J. Fellows and B. Axtell. Opportunities in food processing series, ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA). Wageningen, The Netherlands. <https://publications.cta.int/en/publications/publication/1684>

Small Scale Oilseed Processing. 2007. By Joel Schumacher. Montana State University Extension Service. Briefing Number 88. www.ampc.montana.edu/documents/briefings/briefing88.pdf

The Sunflower Seed Huller and Oil Press
http://journeytoforever.org/biofuel_library/oilpress.html

Research and Education

Fats and Oils Program
Processing Engineering Research and Development Center (PERDC)
Texas A&M Engineering Experiment Station (TEES)
2476 Texas A&M University
College Station, TX 77843-2476
979-845-2740
979-845-2744 FAX
<http://perdc.tamu.edu/fatsoils>

Oilseed Meal and Animal Feeding

Animal Feed Resources Information System —Canola Oil
www.fao.org/ag/aga/agap/frg/afri/Data/724.HTM

Camelina Sativa, A Montana Omega-3 and Fuel Crop. 2007. By Alice Pilgeram, David C. Sands, Darrin Boss, Nick Dale, David Wichman, Peggy Lamb, Chaofu Lu, Rick Barrows, Mathew Kirkpatrick, Brian Thompson, and Duane L. Johnson. In: Issues in new crops and new uses. J. Janick and A. Whipkey (eds.). ASHS Press, Alexandria, VA. www.hort.purdue.edu/newcrop/ncnu07/pdfs/pilgeram129-131.pdf

Canola Meal Feed Guide. Canola Council of Canada. www.canolacouncil.org/publication-resources/print-resources/canola-meal-resources/canola-meal-feed-industry-guide

Specifications on Sunflower Meal. Meal/Whole Seed Feeding of Sunflower. National Sunflower Association. www.sunflowernsa.com/wholesale

Equipment

(Note: Neither NCAT nor the authors of this publication endorse any of the products listed here. This list is intended as a sample, not a comprehensive list of equipment suppliers.)

Grain Moisture Testers

Seedburo Equipment Company
2293 S. Mt. Prospect Road
Des Plaines, IL 60018
312-738-3700
800-284-5779
312-738-5329 FAX
sales@seedburo.com
www.seedburo.com

Seed Cleaners

A.T. Ferrell Company
1440 S. Adams St.
Bluffton, IN 46714
260-824-3400
800-248-8318
www.atferrell.com

This company manufactures Clipper fanning mills.

ALMACO
P. O. Box 296
99 M Avenue
Nevada, IA 50201
515-382-3506
515-382-2973 FAX
sales@almaco.com
www.almaco.com

Oilseed Crushers

Kern Kraft Oilseed Press

The German Kern Kraft oilseed presses range from ¼-ton-per-day to 4-ton-per day capacity. Circle Energy in Wisconsin distributes German Kern Kraft oilseed presses and filters as well as Evolution biodiesel processors. For prices and further information, contact:

Circle Energy
P.O. Box 298
Dodgeville, WI 53533
608-935-5864 or 608-574-7449 or 800-366-3402
info@circle-energy.com
www.circle-energy.com

Biopress Series Oilseed Press

Biopress200
Capacity: 5 tons per 24 hours
CentralBioDiesel
8208 NW 6th St.
Coral Springs, FL 33071
954-889-7BIO (7246)
sales@centralbiodieselhttp.com
www.centralbiodieselhttp.com/en/products/biopress

Rosedowns Mini Oilseed Press

The Mini Press Range has been designed to cover the needs of both the smaller specialty-oil processor and a pilot plant operation. The presses have been designed for cold pressing most oilseeds without pre-treatment. Contact for prices.

De Smet Ballestra
info@Rosedowns.co.uk
www.desmetballestra.com/index.php/equipment/oilseed-a-f-equipment/about-rosedowns
North America/Canada Contact
Paul Keith, pk@rosedowns.co.uk
Keith Ross, kr@rosedowns.co.uk

Other Oilseed Press Manufacturers

Hybren Oilseed Press

The Danish Hybren press is specifically intended for small seeds such as canola and mustard and has a capacity of 1/2 ton per day and retails for about \$4,000. Learn more about these presses at the English page www.hybren.dk/default.asp?language=2

IBG Monforts Oekotec
An der Waldesruh 23
41238 Mönchengladbach
Germany
+492166 8682-45+492166 8682-89 FAX
oekotec@ibs-monforts.de

Skeppsta Maskin AB

Bengt Jonsson
Täby Skeppsta
S-705 94 Örebro
Sweden
+46 19 228005
sales@oilpress.com

The French Oil Mill Machinery, Inc.

Piqua, OH 45356-0920
937-773-3420
937-773-3424 (fax)
<http://frenchoil.com>

The French Oil Mill Machinery manufactures large-scale oilseed crushers as well as a small-scale laboratory oilseed press.

Tiny Tech UDYOG

www.oil-refinery.com

Websites on Other Oils

Palm Oil Processing
www.fao.org/DOCREP/005/Y4355E/y4355e04.htm

Minor Oil Crops – Individual Monographs
www.fao.org/docrep/x5043e/x5043e00.htm

Specialty Olive Oil Production
<http://sfp.ucdavis.edu/pubs/SFNews/archives/94111>



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By Al Kurki, Janet Bachmann, and Holly Hill

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