

Worldwide Processing of Sunflower

Keywords: sunflower processing, sunflower seed processing, de-hulling sunflower seed, sunflower seed roasting, oil extraction of sunflower seed, sunflower meal, sunflower cake pellet, sunflower cake pelletizer, sunflower meal pellet extruder

Abstract: Sunflowers come in 2 types: the non-oil seed and the oil seed, and Mexico, Peru, Russia, Ukraine, Portugal, etc. are the main countries that process sunflowers. Sunflower seed can be processed for confectionery snack food, oil extraction, and sunflower plants can be processed for animal feed, manure, fertilizer and other industrial uses.

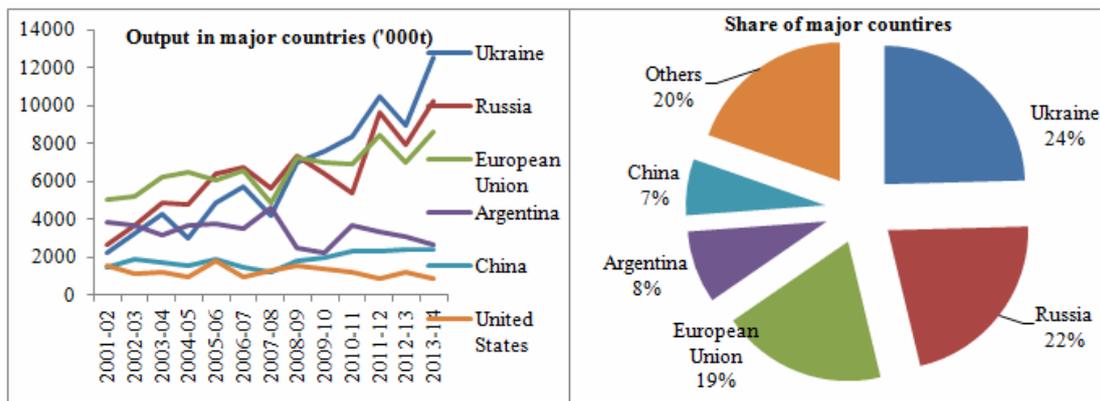
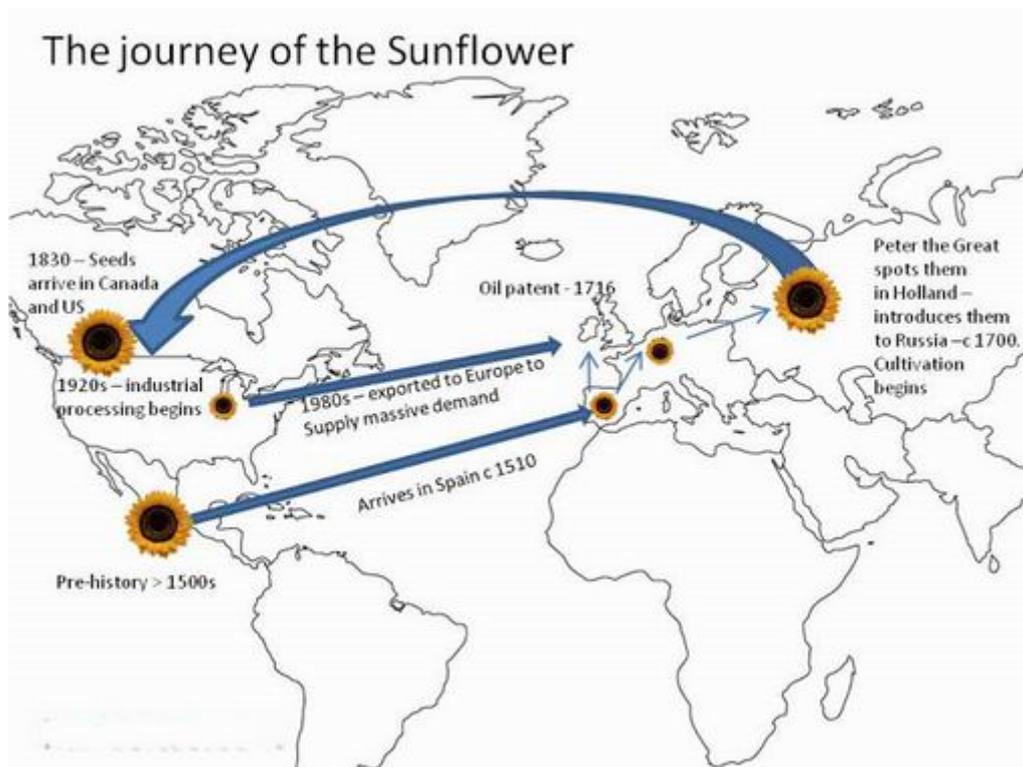


About Sunflower

Sunflower, this name comes from its property of turning its head during the day to follow the sun to get enough energy for its growing. Each big and bright yellow flower head has about 1,000 seeds surrounded the petals. Sunflowers can grow up to 10 feet high, and their roots may grow 6 feet into the ground.

Important Producing Areas around the World

Sunflowers are a minor crop in the Yuma area, and it was introduced from North America into Europe in 1510 by the Spanish, spread into Russia through Europe and now grown in so many countries, which means sunflowers are native to North America. It is thought to originate in present-day Mexico and Peru, and then the seeds are carried to other parts of the world and planted. Today it forms one of the well-known crops in Russia, Ukraine, Portugal, Spain, France, Germany, Italy, Egypt, India, Manchuria and Japan, etc. Globally, Ukraine produced the most sunflower seeds in 2012, followed by Russia and the European Union. And these countries are also the main countries that process sunflowers.



Source: USDA

Sunflower Seed Processing

Sunflower seeds come in 2 types: the non-oil seed that are eaten as confectionery products after roasted with the shell or without the shell as kernels, and the oil seed that are processed into oil and meal which is a by-product of sunflower seed oil extraction primarily used as an ingredient in livestock feed rations.



---Sunflower Non-oil Seed Processing

Non-oil sunflower seeds are also referred to as confectionery sunflowers. Generally, they are stripped and larger than the oil-type, with lower oil percentage. Non-oil sunflower seeds are divided into three categories: food-grade seeds made up of the highest-quality seeds, including the largest and cleanest seeds; ingredient seeds that are still food-grade quality, but do not have the properties of the food-grade category; the smaller, lower-quality seeds for bird feed.

Usually the seeds process includes procedures of drying, cleaning, grading, roasting, sometimes needs flavoring if the plain seeds are not the only requirement, and packing, etc.

1. Drying:

Sunflower seeds after harvesting are rapidly dried to under 10% moisture content by a drying machine, or by sun-drying.

2. Screening and cleaning:

The dried seeds are delivered onto wire screens and shaken to remove dirt and unwanted debris to ensure they can meet the determined specifications. They are next transferred to a large bin for further cleaning.

3. Grading by sizing:

The cleaned seeds are passed on to sizing screens that have holes that allow smaller-sized seeds to fall through. The largest seeds will be further processed as snack foods. The medium-sized seeds are for ingredient-use in topping for cookies, salad, or ice cream, etc. The smallest seeds are for bird or pet feed.

4. Roasting and de-hulling of food-grade seeds:

The largest seeds are transferred to large ovens where they are dry roasted, reducing the moisture level in the seed further; or after de-hulling the largest seeds, they are transferred to the ovens for roasting. The medium-sized seeds are directly sent to de-hulling machines to remove their shells, and then roasted in oil.

5. Flavoring of food-grade seeds:

The food-grade seeds can be flavored as required. Flavoring can be accomplished in many ways. The warm seeds after roasted are put into a large, rotating container that make the seed move around, combining with the flavoring. Sometimes the oil is used to make better flavoring result by making seeds and flavorings stick better.

6. Packing:

In the last step, the seeds are delivered to packaging machines, in which the sunflower seeds are weighted and packed.

---Sunflower Oil Seed Processing

In 1716, the British got the success in oil extraction from sunflower seeds, and the sunflower seed oil had a worldwide attention from then on. The success of sunflower seed oil extraction promoted the research and extension of sunflowers' varieties, however, it was not until the 19th century sunflowers were still taken as ornamental plants or dry nut snacks. It is after the middle 20th century when sunflowers were planted as oil crops with large areas, and with years' hard research work, the former Soviet Union sunflower specialists increased the oil ratio from 35% in 1935 to 45% in 1955, and some sunflower varieties had an oil ration of 55%. The achievement made the sunflower become an oil crop around the world. By the mid-20th century, the improved sunflower variety had been introduced to China, India, Vietnam, Brazil, etc, countries.

Except the limited industrial applications in paints, varnishes and plastics, manufacture of soaps and detergents, production of agrichemicals, surfactants, adhesives, plastics, fabric softeners, lubricants, and exploration of diesel fuel, etc. the sunflower seed oil is commonly used as edible oil.

The oil accounts for 80% of the value of the sunflower crop. Sunflower seed oil is generally considered as a premium oil for its light color, rich unsaturated fatty acids, bland favor, high smoke point and low linolenic acid. As the edible oil, sunflower seed oil primary uses are as salad or cooking oil or in margarine.

Sunflower seed oil is cold-pressed. The cold-press entails minimal processing to produce a light, flavorful oil suitable for some cooking needs. Sunflower seed oil manufacture involves seeds cleaning, seed de-hulling, seeds grinding, seeds pressing and extracting crude oil, crude oil refining.

1. Cleaning:

The prepared sunflower oil seeds are passed over magnets to remove the trace metal before de-hulled; and passed the special cleaning machine to remove other foreign matters.

2. De-hulling (optional)

Sunflower seeds from the oil-type contain about 20%-30% hulls that are sometimes removed before oil extraction to ensure the quality of both oil and sunflower meal. De-hulling is done when the seed has a moisture content of 5% after cleaning. The usual process consists of cracking the seeds by the mechanical action of centrifugal or pneumatic sheller, which can also be completed by abrasion. Then the resulting mixture is winnowed to separate the hulls from the kernels. Some oil sunflower seeds have thin hulls that are difficult to remove, so they can be free from de-hulling to avoid oil loss.

Sunflower seed de-hulling process with freezing in Ukraine

There are 2 levels: the low level and the high level, and the seeds with initial moisture content 5.1% are separated from foreign matters on the sieves.

The sunflower seeds are dried in a chamber drier to get 1.2% seeds moisture content. Temperature of the seeds is kept below 80°C during drying process. To get 9.2% moisture content, the seeds are placed in the wet medium (wet cotton tissue) for 30 minutes.

The installation for seeds freezing consists of vessel, detachable cap insulated with polystyrene foam, temperature controlling device (thermocouple) and doser of liquid nitrogen. The coming sunflower seeds are placed in the vessel, where is fed with liquid nitrogen with 4ml/min feed rate while the temperature of seed freezing is reached, then the frozen seeds are de-hulled immediately. De-hulled seeds are separated on the sieves to isolate the oil dust and damaged kernels, and then the kernels, hulls, non-damaged seeds, non-dehulled seeds are separated manually.

3. Grinding:

The prepared sunflower oil seeds are passed over magnets to remove the trace metal before de-hulled. For more surface area to be pressed, the de-hulled seeds are grounded into coarse meal of proper consistency by mechanized grooved rollers or hammer mills. Then the meal is heated to facilitate the oil extraction. While during oil pressing, some impurities are also released with the oil, and they should be removed before the oil can be edible.

4. Pressing:

The heated meal is then fed continuously into a screw press, which increases the pressure progressively as the meal passes through a slotted barrel. Pressure generally increases from 68,950 to 206,850 kilopascals as the oil is squeezed out through the slots in the barrel, and is recovered.

5. Extracting additional oil with solvents:

After the initial oil is recovered from the screw press, the oil cake remaining in the press can be processed by solvent extraction to get maximum yield. A volatile hydrocarbon (the most commonly used one is hexane) dissolves the oil out of the oil cake, and then the oil is recovered by distilling the solvent out, and then the solvent passes through the matter to be collected at the bottom.

6. Removing solvent traces:

90% of the solvent remaining in the extracted oil simply evaporates and it is collected for reuse. The remaining solvent is regained by the use of the stripping column. The oil is boiled by steam, and the lighter solvent floats upward, as it condenses, it is collected at the same time.

7. Refining the oil:

Refining the oil is to remove color, odor and bitterness. Refining involves heating the oil to 40° C -85° C (107-188 degree Fahrenheit) and mixing an alkaline substance such as sodium hydroxide or sodium carbonate with the oil. Then soap forms from the undesired fatty acids and the alkaline additive, and usually it is removed by centrifugal process. The oil will be further cleaned to remove soap traces and then dried.

The oil is also de-gummed at this time by treating it with water-heated steam of 85° C -95° C (188-206 degree Fahrenheit), or water with acid. Most of the gum is the phosphatides to be precipitated out, and the dregs are removed by centrifugal process.

Oil that will be heated (for use in cooking) is then to complete bleaching by filtering it through fuller's earth, activated carbon, or activated clay that can absorb some pigmented materials from the oil. By contrast, oil that will be refrigerated (for use in salad) is rapidly chilled and filtered to remove waxes. This procedure is to ensure the oil will not partially solidify in the refrigerator.

The final process is the deodorization of the oil, in which the steam is passed over hot oil in a vacuum at 225° C - 250° C (440-2485 degree Fahrenheit) to distill the volatile and odor components from the oil. Typically, to avoid the trace metals that might promote oxidation within the oil and hence shorten the oil's shelf-life, 1% citric acid will also be added into the oil after deodorization.

8. Packing the oil:

After completing all the processing, the pure oil is normatively measured and packed in clean containers, and the usual ones are bottles for domestic sale, glass bottles for exports or domestic sales in specialty stores, or cans for exports.

---By-product/waste in Sunflower Seed Oil Production



The most common product of the sunflower seed oil making is the oil seed cake/meal, which is usually used to make animal feed and low-grade fertilizer or partly disposed. Sunflower meal is a successful substitute for soybean meal in equal protein diets for ruminant animals, as well as for swine and poultry feed. Because sunflower meal is lower in energy value and lysine, but higher in fiber and methionine than soybean meal, and it is also rich in protein. Due to the extraction process and de-hulling degree, the meal color ranges from gray to black.

The sunflower oil extraction industry produces 3 kinds of meal.

1. Meal produced from dehulled seeds, containing around 28% protein and 25%-28% fiber.
2. Meal produced from partially de-hulled seeds, containing 35%-37% protein and 18% fiber;
3. Meal produced from seeds with 2-step de-hulling process, containing 40%-42% protein and 12%-14% fiber.

The meal composition thus depends on the efficiency of the de-hulling, and the oil content of sunflower meals ranges from 1.5% to 2.5%, depending on oil extraction efficiency and raw materials. Fresh sunflower meal must be dried for optimal storage. It can be ground, broken into small pieces or pelletized for easy handling and storage by processing under high pressure in a pelletizer or extruder, with an addition of proper binder such as molasses, fats, etc.

Extra Sunflower Processing for Uses

Sunflower plants as livestock feed:

Its leaves are preferred by rabbits, horses, cows and other livestock. The raw green leaves can be gathered to make the good-quality succulent green feed for the poultry of all ages, or they can be finely minced as a kind of feed addition for young and adult livestock, or they can be boiled and added in the soft feed. At the same time, the dried leaves as well as the ripe seeds can also be the feed addition by being well scalded and then processed into a meal form. Sunflower can also be used as a silage crop, like corn and grass hay.

Stems and seedless heads as animal house bedding:

The used stems and heads may be preferred to use as livestock house bedding after drying and cutting with other grain litter.

Stems and seedless heads as fuel, as manure:

After the stems and empty heads are dried, they have the same good quality with wood as fuel to make fire. Or burn the dried stems and empty seed heads to gather the potash with a considerable manure value which can be spread in the fields of potato or other root crops before plantation.

Sunflower plants as medicine: sunflower seeds has diuretic and expectorant properties, so they have been applied for the treatment of bronchial, laryngeal and pulmonary affections, coughs and colds, also whooping cough; the tincture contained in flowers and leaves has been recommended in the treatment of bronchiectasis combining with balsamics; the seed can relief whooping cough after browned in the oven and made into an infusion, an also the prepared tincture can be used for intermittent fever and ague.

In addition, the raw seed can be ground into a meal to thicken soups and stews. Roasted hulls can be used to make a brew similar to coffee. Dye can be extracted from hulls and petals and face paint can be made from dried petals mixed with pollen. The growing sunflower plants is extremely helpful for dry damp soils for its remarkable ability of absorbing water; it is believed that sunflower plant can be for textile use for its large portion of fiber mixed with silks; sunflower is a good bee plant, as it supplies honeybees with large amount of wax and nectar; its unexpanded seed heads can be boiled and served as a pleasant dish like the Artichokes.